The Heating and Ventilating Magazine

A MONTHLY JOURNAL OF ENGINEERING PROGRESS

Vol. XX. No. 1
$2.00 a year. 20 cents a copy

JANUARY, 1923

Published at Cooperstown, N. Y.
New York Office, 1123 Broadway

If you want a better air valve at a lower price—send for our diagram blue print showing detailed specicfiations, prices and discounts.

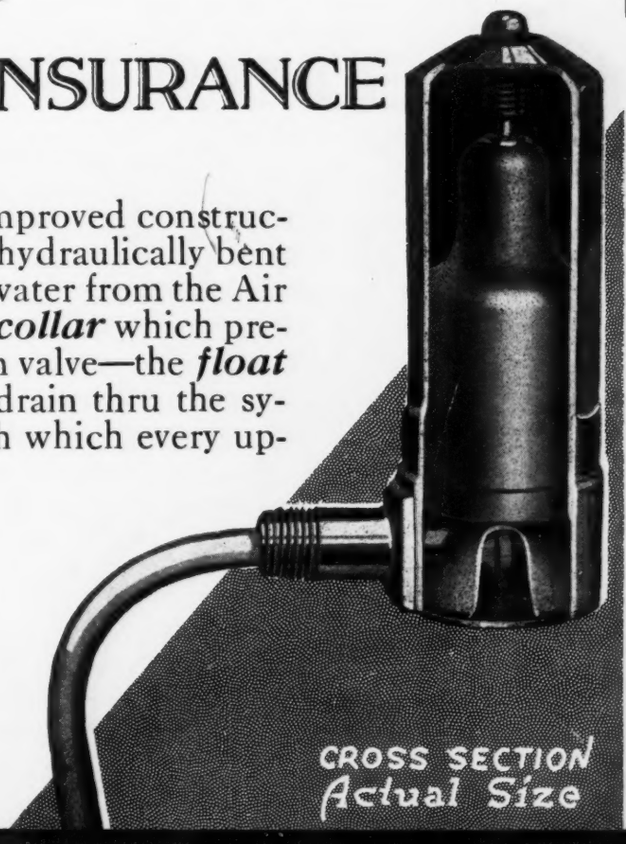
The Dole Syphon Air Valve

After many years of experience in making **quality valves** we now take pride in offering the **Dole Syphon Air Valve.** We believe that this valve more nearly reaches perfection than any valve that has ever been produced. The Dole Syphon Air Valve embodies "Dole Thermostatic Principles," quality of materials and workmanship and is offered at a price that will show a long trade profit.

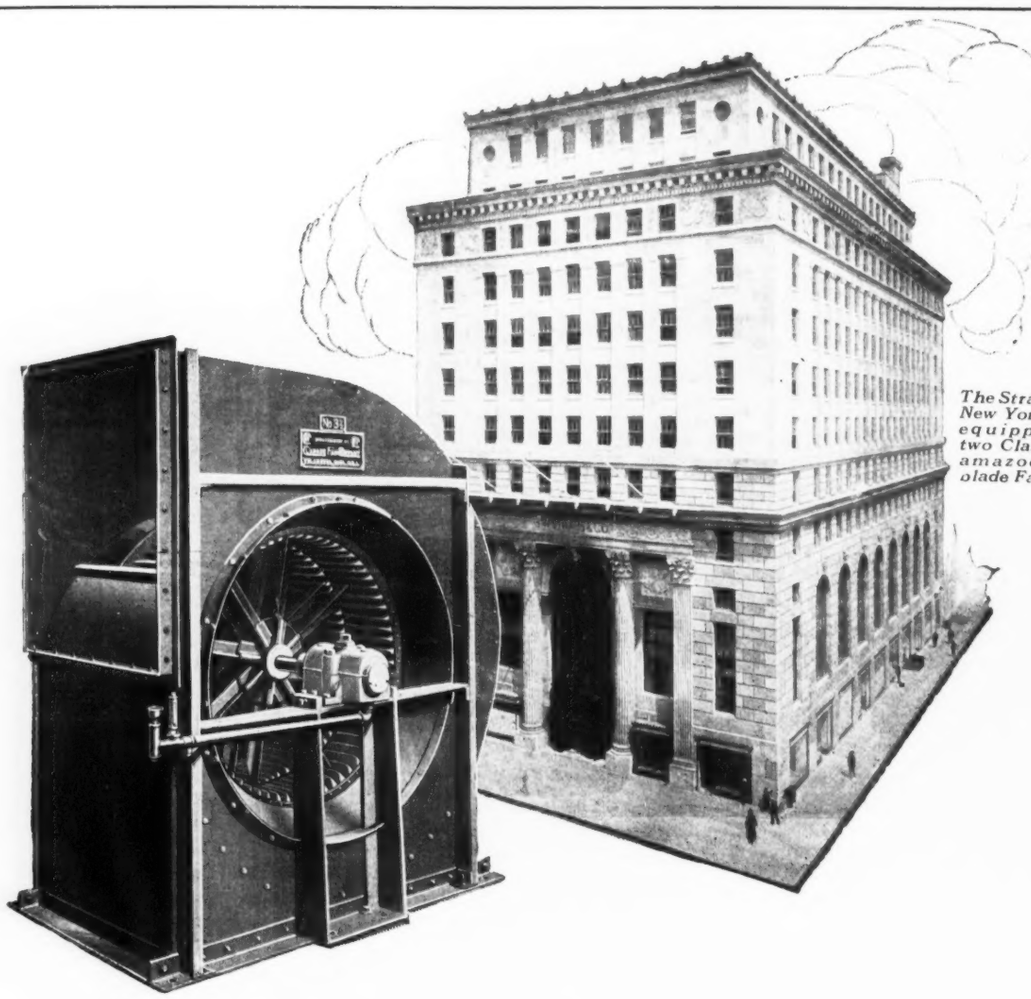
HEAT INSURANCE

The efficient construction of the ***venting seat***—the improved construction of the ***Dole Syphon*** which is made in one piece hydraulically bent to the proper shape thus insuring the positive drain of water from the Air Valve back to the radiator—the special ***syphon lock collar*** which prevents accidental or intentional removal of syphon from valve—the ***float rest*** which is open on four sides permitting water to drain thru the syphon, are just a few of the special ***Dole features*** with which every up-to-date steam fitter should be familiar.

And Dole Syphon Air Valves are built for endurance. Once installed they ***assure the life of the heating system.*** Again we say if you want a better air valve at a lower price send for our diagram blue print showing detailed specifications; also prices and discounts.



The Dole Valve Company
1925 Carroll Ave. **Chicago, Ill.**



The Straus Bldg., New York City, is equipped with two Clarage Kalamazoo Multiblade Fans.

Better fans—better men

WHAT steam is to an engine, air is to a man.

A steam engine with half enough steam—impossible!

A man with half enough air—common!

Without considering the humanitarian side, viewed merely from a standpoint of dollars and cents, a high priced man deprived of good air and good ventilation is, like an under supplied engine, a bad investment.

Adequate ventilation is simply a matter of choosing the correct type of the right equipment. Consistently excellent service records in hundreds of America's architectural landmarks have shown that there is no more dependable fan or ventilating equipment than that bearing the established name, Clarage Kalamazoo.

Clarage engineers, backed by unsurpassed experience in ventilating problems, are constantly cooperating with heating and ventilating engineers. They are helping engineers to specify equipment that will make the finished job a credit to their ability.

Ask for complete information about Clarage Kalamazoo Fans, Ventilating Equipment and Humidifying Systems. Or interview a representative of the Clarage engineering staff and become acquainted with the valuable service offered by this organization.

Clarage Fan Co., Kalamazoo, Michigan and Principal Cities

CLARAGE
—KALAMAZOO

pp. 29-32 = index for Vol 19.

The Heating and Ventilating Magazine

VOL. XX. NO. 1

Contents for January, 1923

Aerology for Amateurs and Others I.....*E. Vernon Hill* 35
The Evolution of Modern Ventilation and Its Effect on Present and Future Practice.

Heating and Power Cost Analysis of Office Buildings..... 40
Based on Actual Figures Compiled During 1921 and Covering 150 Buildings Located in 47 Cities.

Construction Mechanism and the Centrifugal Fan.....*George D. Beals* 42
Points to Be Considered in the Design of an Apparatus Capable of Meeting Given Requirements.

Squeezing the Waste Out of Industry..... 47

Space Requirements for Mechanical Equipment (Concl'd).....*H. L. Clute* 48
The Amount and Location of Quarters Usually Available for the Various Utilities and the Form of Building Construction that Will Facilitate Their Installation.

American Storms Which Figure in the Work of the Heating Engineer..*G. J. O'Connor* 51
Hurricanes, Cyclones and Tornadoes Compared with Asiatic Typhoons and Monsoons.

Commission Cutting is Wrong. Let's Stop It..... 53

The Weather for November, 1922..... 54
New York, Boston, Pittsburgh, Chicago and St. Louis.

New Oil-Burning Regulations for Domestic Equipments..... 56

Fire Hazards of Emergency Heating..... 57

Correspondence..... 58
The Analogy Between Water and Air Flow in Conduits.
The Gas House-Heating Experiment in Denver.

How One Newspaper Interpreted the Report of the New York State Commission on Ventilation..... 58

Annual Meeting of American Society of Mechanical Engineers..... 58

Portland's Electrically-Heated Apartment House..... 59

A Restful Atmosphere as a Paying Proposition..... 59

Fuels Division of A. S. M. E. Publishes Revised Rules for Coal Conservation..... 60

January Will Mark Crisis in New York City's Coal Plight..... 61

Substitute Coal Order Issued in New York City..... 61

American Society of Heating and Ventilating Engineers..... 62
Plans for Annual Meeting.
Chapter Organized in Wisconsin.
Organization of Columbus Chapter.
New York Chapter Given Description of Cornell University's Central Heating Plant.
Manufacturing and Firing of Coke Discussed by Western New York Chapter.
Talk on Heating Calculations Before Philadelphia Chapter.
Illinois Chapter Has a "Stunt" Night.
Heating Methods of the Future Discussed by Illinois Chapter.

A. S. M. E. Adopts National Code of Ethics..... 63

Portable Unit Ventilators..... 64
2—The Peerless Unit System.

National Trade Extension Bureau.
Making Business More Profitable.
1923 Calendar of the T. E. B. Advertising Campaign.

New York's Successful Power Show..... 69

Heating and Ventilating Data Sheets..... 74
No. 13-GG—Radiation Computing—Steam Heating, Floors.
No. 13-HH—Radiation Computing—Water Heating, Floors.
No. 13-II—Radiation Computing—Steam Heating, Ceilings.
No. 13-JJ—Radiation Computing—Water Heating, Ceilings.

Advertisers' Index, Page 114.

Engineers' Specification Index, Page 108.

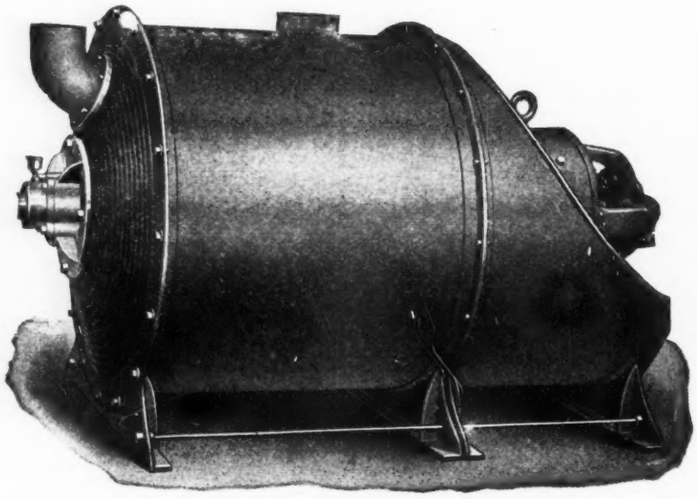
YEARLY SUBSCRIPTION $2.00 **SINGLE COPIES, 20 CENTS**

Published monthly at Cooperstown, N. Y., by the Heating and Ventilating Magazine Co.
Executive and Editorial Offices 1123 Broadway, New York

Entered as second-class matter at the Post Office in Cooperstown, N. Y.
Copyright, 1922, by The Heating and Ventilating Magazine Co.

Send for list of references of school installations and complete data regarding the Spencer equipment.

Spencer Turbine Cleaning Systems



Horizontal slow speed Spencer Turbine vacuum cleaning exhauster. Direct motor driven, wide clearance, multistage type equipment.

particularly developed for the cleaning of school buildings in a sanitary manner without spreading dust in the air, and giving the most thorough and rapid cleaning for school buildings.

Spencer systems are chosen by those who have had the most experience with vacuum cleaning apparatus in school buildings.

THE SPENCER TURBINE COMPANY
Hartford, Conn.

Still another service derived from The Johnson Pneumatic System of Temperature Regulation is that the apparatus and their principles are beyond any and all stages of experiment. When a customer receives Johnson Service equipment and installation there remains no cause for even a question as to application and results. And with the vital essential of temperature control being performance after installation, and not promises before, this Johnson feature of service is a priceless safety measure as well as surety: importantly worth more than passing notice.

The Johnson Service Company by providing their thermostats and diaphragm valves with metal diaphragms now offer a system of regulation which will not wear out, deteriorate with age, or require repairs due to deterioration of material.

The Heating and Ventilating Magazine

A MONTHLY JOURNAL OF ENGINEERING PROGRESS

JANUARY, 1923

Aerology for Amateurs and Others

The Evolution of Modern Ventilation and Its Effect on Present and Future Practice

BY E. VERNON HILL

CHAPTER I.

Historical Sketch

IN DISCUSSING the subject of ventilation from the historical standpoint one usually begins with the incident that occurred on a night in June, 1758, when 123 Europeans lost their lives in the "Black Hole" of Calcutta. The hole, or rather the room, was 18 ft. or 20 ft. square and ventilated only by means of two small windows opening on to a porch. One hundred and forty-six Europeans were confined in this space over night and in the morning twenty-three were found alive.

The "Black Hole" was a dungeon in the fortress of Calcutta and it was at the time that this city was captured by the native forces under Suraj-ud-Dowla, and the occupants of the garrison thrown into the "Black Hole," that this incident occurred. The report of Mr. Holwell, who was in charge of the garrison at the time, is a record of unusual interest. He states that the persons incarcerated in this dungeon were crowded into the restricted space early in the evening. The room was so crowded that the door was closed with difficulty. About 9:00 o'clock the distress of the occupants became very great, frequent cries for water were heard, and after paying one of the guards an enormous price a hatful of the precious liquid was finally passed through one of the open windows. Owing to the struggle to obtain a portion the entire contents were spilled upon the floor and panic followed.

About ten o'clock, Mr. Holwell states, the men were dropping fast and by eleven or twelve o'clock the greater portion were lying on the floor in a dead or dying condition. When morning dawned twenty-three were taken out alive. The dead bodies were also removed by the guards and thrown unceremoniously into a ditch close by.

This incident has always been used as an illustration of the fatal effects that are possible under extreme conditions of poor ventilation, and it has always been supposed that the toxic substance expired by the persons in this enclosure were the cause of the deaths of the large number mentioned. It was probably due to this incident and to others that were similar, although less fatal, that the popular opinion prevailed regarding the toxity of expired air. This opinion

Existing text books on ventilation usually devote the first chapter to the chemical constituents of the air, the proportions of oxygen and nitrogen, the moisture content and the amount of CO_2 to be found both in the city and at the seashore. The author usually devotes some space to the necessity of an abundant supply of fresh air and gives statistics and standards of air purity on the CO_2 basis.

The balance of the book usually treats of mechanical devices for introducing outside air into a building, the selection of fans, the capacity and efficiency of motors, the design of duct systems, etc., with perhaps some data on humidification, air cleansing and temperature control.

Very little has been written respecting the desirable air conditions to be maintained in a room and how these conditions are brought about. This is not mentioned as a criticism of existing text books on the subject, nor do we think that the mechanical side of ventilation has been given undue prominence. Rather let us say that it has progressed much faster than the physiological side of the subject, until at the present time the latter lags in the rear.

It has been the author's desire and endeavor for many years past to develop the physiological side of the science, to establish definitely requirements for proper ventilation, and to develop and standardize test methods and instruments for this work. The following pages, therefore, are devoted to a discussion of the known factors that determine the suitability of air conditions to the human body, their relationship and relative importance, and to the instruments and methods we have found best adapted for testing and studying the same.

was not confined to the laity but was until recent years taught by hygienists everywhere. The true cause of the deaths in the "Black Hole" will be discussed in connection with the "Wet Bulb Temperature."

"CROWD POISON"

The old term "crowd poison," which is still occasionally met with in literature, was the name given to this supposedly deleterious substance, and the carbon dioxide given off in respiration was thought to increase the harmful effects. However, as far back as 1842 Le Blanc demonstrated that carbon dioxide could not be held accountable for the effects in question. He confined animals in an atmosphere containing as high as 300 parts of CO_2 per 10,000 parts of air without particular harm, provided the amount of oxygen was raised to 70%. The belief in the toxic effects of carbon dioxide slowly lost ground from this period and we find that in the '60s Von Pettenkofer took the position that CO_2 was harmless under ordinary conditions that might obtain in poorly ventilated rooms. He taught, however, that toxic substances were given off by the breath in proportion to the amount of CO_2 eliminated. He used the CO_2 content, therefore, as an index of air contamination in a room, believing that this substance increased proportionately with the toxic substances referred to. His standards of ventilation and allowable portions of CO_2 were accepted for many years as establishing the requirements for proper ventilation.

INVESTIGATIONS OF THE TOXICITY OF EXPIRED AIR.

It must not be understood that the prevalent views regarding the injurious substance in expired air gained credence without substantial scientific reasons for this belief. In 1887 Brown-Sequard and d'Arsonval conducted animal experiments which for a long time were considered as being positive proof of the correctness of this theory. They confined animals in cages connected together in such a way that air was passed through each compartment in series. The animals, therefore, breathed vitiated air from the preceding cages in the series and the extent of this vitiation depended upon the position of the cage in question. These investigators found that the animal in the last cage, in other words the one which had breathed the air from the others, was the first to succumb, the next to the last died second, and the animal in the first cage remained alive. They also found that when the air entering the last cage was purified, by passing it through a concentrated solution of sulphuric acid, the life of the animal in this cage was saved. This appeared to be conclusive evidence of the toxicity of expired air. Doubt, however, was thrown upon the result of their experiments by the work of others in a similar field who failed to obtain the striking results recorded by these investigators.

In 1895 Billings, Mitchell and Bergey announced the results of their experimental work, which tended to disprove the theory of any special toxicity in expired air. They attributed the ill effects to a dimunition in oxygen and an increase in carbon dioxide, or a combination of the two, and called particular attention to excessive temperatures and unpleasant odors as being the chief causes of the discomfort of people in a poorly ventilated room. From this time on attention was directed more and more to these so-called physical factors in ventilation.

EARLY REFERENCES TO THE WET-BULB TEMPERATURE.

J. S. Haldane in 1902, in his evidence given before the committee to investigate the ventilation of the cotton weaving sheds in England, laid particular stress on the temperature and humidity of the air, and to a less extent on air motion, and stated that in his opinion the important thing that determined the comfort of workers was the *wet-bulb temperature*. He recommended at this time that a wet bulb of 75° F. should be established as a maximum for this industry.

In 1905, Heymann, Paul and Ercklentz, working in Flügge's laboratory, conducted a series of experiments that marked an epoch in the theory of ventilation. Their work is now considered a classic and is so well known that their experiments will not be repeated. Suffice it to say that they found when men were confined in an air-tight compartment, in which the air was rebreathed and the carbon dioxide and other products of respiration reached a supposedly alarming condition, no immediate harmful effects, or even discomfort were caused if the temperature and humidity were not allowed to increase above a certain point. If, however, the temperature and humidity were allowed to increase beyond this point the distress of the subjects was manifest. This could be alleviated by increasing the air motion about their bodies by the use of a small electric fan. In other words, these experiments brought out in a conclusive manner the fact that the distress occasioned by confinement in a poorly ventilated room was almost always due to high temperatures and humidities and to lack of air motion, and not to the carbon dioxide or organic impurities in the expired air.

Some experiments conducted under the direction of Leonard Hill in the physiological laboratory of the London Hospital Medical College since that time confirmed Flügge's results. Hill's experiments were also conducted in a cabinet and extend over a period of several years and included a large number of separate tests. Some of the conclusions drawn in the report on this work are of interest, the following are quoted:

1. "No symptoms of discomfort, fatigue or illness result, so long as the temperature and moisture are kept low, from air rendered, in the chemical sense, highly impure by the presence of human beings. Such air can be borne for hours without any evidence of bodily or mental depression. At 80° F. with moderate humidity, or 70° to 75° F. with high humidity, almost all persons begin to show depression, headache, dizziness and a tendency to nausea. . . . The subjective symptoms appear when the surface temperature reaches a certain height, for example 92° to 95° on the forehead and the relative moisture of the layer of air in contact with the skin increases 20% to 30%. Under these conditions the normal loss of body heat is interfered with and symptoms appear which are similar in every way to those produced in stuffy, crowded rooms.

2. "Heat stagnation is, therefore, the one and only cause of the discomfort, and all of the symptoms arising in the so-called vitiated atmosphere

of crowded rooms are dependent on heat stagnation. The moisture, stillness and warmth of the atmosphere are responsible for all the effects, and all the efforts of the heating and ventilating engineer should, therefore, be directed toward cooling the air in crowded places and cooling the bodies of the people by setting the air in motion by means of fans.

3. "The increased percentage of carbon dioxide and the diminution of oxygen which have been found to exist in badly ventilated churches, schools, theatres and barracks are such that they can have no effect upon the incidence of respiratory disease and the higher death rate which statistical evidence has shown to exist among persons living in crowded and unventilated rooms. The conditions of temperature, moisture and windless atmosphere in such places primarily diminish the heat loss, and secondly the activity of the occupants, as also the total volume of air breathed, oxygen taken in and food eaten. The whole metabolism of the body is thus run at a lower plane, and the nervous system and tone of the body are unstimulated by the monotonous, warm and motionless air. At the same time the number of pathogenic organisms is increased in such localities and the two conditions run together—diminished immunity and increased mass influence of infecting bacteria.

4. "In the warm atmosphere of a crowded place, the infection from spray, sneezed, coughed or spoken out, is great. On passing from such an atmosphere out into the cold, moist external air the respiratory mucous membrane is suddenly chilled, the blood vessels are constricted, and the defensive mechanism of cilia and leucocytes is checked, hence the prevalence of colds in the winter."

FINDINGS OF THE NEW YORK STATE COMMISSION ON VENTILATION.

The New York State Commission on Ventilation was organized in June, 1913, from a fund donated by Mrs. Elizabeth Milbank Anderson for improving the conditions of the poor. The commission equipped an experimental room in the College of the City of New York for investigating ventilation problems. The room was arranged so that practically any air condition required could be maintained within very accurate limits. Students, workmen, clerks, etc., were used as subjects in this room over periods of time varying from a few hours to as many weeks. The reports of their investigations now completed are to be found in the Proceedings of The American Society of Heating and Ventilating Engineers and the Journal of The Amerthe Journal of The American Public Health Association. The findings of the New York Commission verify the results of Flügge and Leonard Hill and add certain important details that are of considerable interest. Some of their results may be summarized as follows:

1—Persons subjected to vitiated air over extended periods of time show a distinct loss of appetite and in the amount of food consumed.

2—Increase in the temperature above a certain point lessens the inclination to do physical work without a corresponding decrease in the individual's capacity for the same.

3—An increase in the temperature as above noted does not appear to lessen the *inclination* to do mental work nor does it reduce the capacity.

4—Subjecting animals to chilling and overheating diminishes their resistance to infection. Furthermore, the production of protein substances in the blood, notably hemolism and agglutinin, are found to be less than in those animals which are kept in a normal environment.

5—Persons subjected to high temperatures showing a swelling of the mucous membrane lining the interior turbinates of the nose, with a distinct tendency to diminished breathing space, increased secretions and reddening of the membrane. The action of cold, as a rule, has the opposite effect, reducing the size of the turbinates, diminishing secretion and color.

Valuable studies in air currents, in the prevalence of dust under various conditions, the effect of humidity on blood pressure, etc., have also been made by the New York Commission—studies that widen the field of our knowledge and enrich the literature on this subject.

WORK OF CHICAGO COMMISSION ON VENTILATION AND CHICAGO HEALTH DEPARTMENT.

The Chicago Commission on Ventilation was organized in February, 1910, three years previous to that of the New York Commission. Their efforts have been directed rather toward investigations of practical problems in this field, particularly toward the results obtained by the operation of mechanical installations and comparisons of these with rooms ventilated by means of gravity and indirect systems and by windows alone.

In June, 1912, the Ventilation Division of the Chicago Health Department was organized, under the direct supervision of the writer, for the purpose of enforcing the ventilation ordinance of the new building code. While the efforts of this organization are primarily directed toward law enforcement, nevertheless some time has been given to analyzing and studying the test data that accumulates and doing a certain amount of research work that has a direct bearing on these problems.

HOW THE OLD CONCEPTIONS AS TO DESIRABLE AIR CONDITIONS HAVE CHANGED.

In reviewing the investigations and results of the past few years, it is evident that a marked change has occurred in our conception of desirable air conditions, nothing revolutionary as many suppose but a decided shifting of the importance of the various factors involved. The old theory of poisonous substances in expired air has sunk into insignificance. The belief that carbon dioxide *per se* is injurious under ordinary conditions has disappeared. In its place the importance of temperature, humidity and air motion as it affects heat dissipation from the body has gained universal recognition. We find at various points in the investigations referred to, reference to these three factors and occasionally to certain relations existing between them. One of these relations was emphasized by the Chicago Commission's work in the test room of the Chicago Normal School, in which observations as to the relation between temperature and humidity were made on

the pupils engaged in their studies. One hundred and fifty-two (152) observations were made as to the comfort of the pupils, and the results plotted in the form of a chart, which was designated "The Comfort Zone Chart" and presented by Professor Shepherd at the summer meeting of The American Society of Heating and Ventilating Engineers, in Buffalo, in 1913.

DEVELOPMENT OF "COMFORT ZONE CHART."

The original arrangement of this chart was not such as to bring out the comfort zone to the best advantage. While studying this matter in 1914, I connected points of the same character with lines, thus dividing it into five zones, the so-called "Comfort Zone" running diagonally across the chart from the upper left-hand corner to the lower right-hand corner. Through the center of this zone a straight line was plotted, which we called the line of comfort (see Fig. 1). Any point taken on this line indicates the combination of temperature and relative humidity that is most comfortable for a person at rest and in ordinary attire. The chart has been more or less extensively used since that time and was until recently the best experimentally-compiled test data on this subject.

The following winter in going over a number of tests conducted by the Ventilation Division engineers of the Chicago Health Department in buildings of various types of occupancy, it developed that in numerous instances, where the relations between temperature and humidity were in accordance with the Comfort Zone Chart, the occupants complained of being too cold. This was especially true where the humidity was low. In fact, it appears to be the rule rather than the exception that rooms where a temperature of 70° F. and a relative humidity of 30% or less are maintained, are not warm enough for the average individual at rest.

It was evident from the foregoing that one factor which may be of considerable importance in determining comfort is not given consideration in this chart, and that is the question of *air motion*. If there is any perceptible air motion a higher temperature or humidity; *e. g.*, a higher wet-bulb must be maintained.

After giving this matter considerable study I came to the conclusion that more definite information regarding relations of temperature, humidity and air motion to each other in their bearing on comfort must be secured. In October, 1916, I discussed this problem at a meeting of the Illinois Chapter of The American Society of Heating and Ventilating Engineers and suggested that the society take up the question and make some tests to throw much needed light on this subject. I stated that a room should be equipped so that any combination of temperature, humidity and air motion could be maintained and their relations experimentally determined. Mr. A. H. Schroth immediately volunteered to equip such a room in his factory building without expense to myself or the society. Needless to say this generous offer was accepted and the work started immediately.

EQUIPMENT OF CHICAGO EXPERIMENTAL ROOM.

A small store room 26½ ft. long and 11 ft. wide, with a 13 ft. ceiling was fitted up as a test room. The room faced on Rush street. A smaller room at the rear was used for a waiting room for the subjects. In the test room three cast-iron radiators were connected to a riser on the south side of the rooms, the radiators consisting of 50, 100 and 150 sq. ft., respectively, so arranged that 50, 100, 150 or 200 sq. ft. could be used as desired. On the same riser near the ceiling a 2-in. pipe was connected and arranged so that live steam could be admitted through a perforated portion of the pipe to increase the humidity to any point desired.

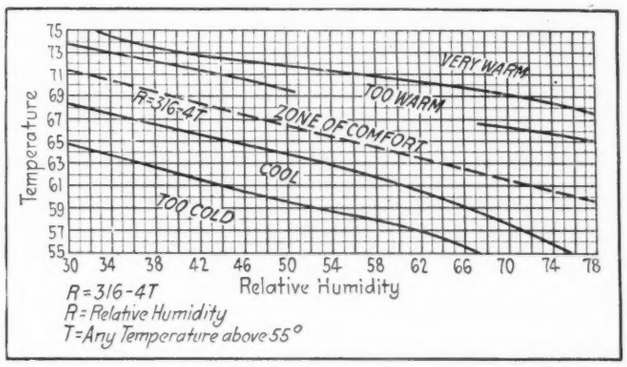


FIG. 1—THE WELL-KNOWN "COMFORT ZONE" CHART.
Plotted from J. M. Shepherd's Tests in the Experimental Room of the Chicago Normal College by Dr. E. V. Hill.

In the center of the room, at the east end, a 30-in. centrifugal fan was installed with suitable speed control and the floor laid off in front of the outlet at 2-ft. intervals. By moving the chair of the subject backward or forward along the scale on the floor, and by changing the speed of the fan, any air velocity could be obtained from 0 to 2800 ft. per minute. By properly manipulating the direct radiators and the humidifier, a temperature range was obtained from 28° to 94°, and a relative humidity from 100% to 18%. A cardboard screen was used to protect the subject from the radiant heat from the radiators.

Some preliminary tests were first made with various combinations of temperature, humidity and air motions selected at random. Later we adopted the procedure of selecting a certain air velocity, say, for instance, 300 ft., with a humidity as high as possible and the temperature as low as possible, then by increasing the temperature, the humidity was lowered and observations made as to comfort with these variations, the velocity remaining constant.

HOW TESTS DISCLOSED SIGNIFICANCE OF WET-BULB TEMPERATURES.

In all, 37 tests were made, most of them repeated with two and sometimes three subjects. No attention was paid at this time to the wet-bulb temperature, the idea being to determine what combinations of dry-bulb and relative humidity were comfortable at certain air velocities. After completing these records, however, Mr. Charles Freund, who was compiling the data and plotting the curves, noticed that the comfortable wet-bulb temperature was surprisingly constant for any given velocity and that this wet-bulb increased with the velocity. The averages of the wet-bulb temperatures at each velocity were, therefore, taken, it being clear that there was a comfortable wet-bulb temperature for each velocity, and the comfort curve plotted as shown in Fig. 2. This curve indicates that without air motion

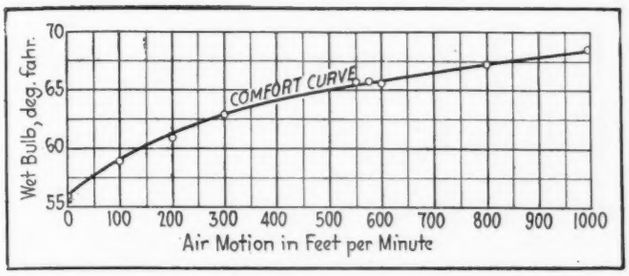


FIG. 2—RELATIONS BETWEEN AIR MOTION, TEMPERATURE AND COMFORT.

a wet-bulb temperature of 56° is comfortable. With a 100-ft. velocity the wet-bulb should be decreased to 58°. At a 300-ft. velocity the wet-bulb should be 63°, etc., the wet-bulb increasing directly with the velocity.

APPLYING THE TEST RESULTS TO THE ZONE CHART.

The fact that our tests showed a wet-bulb of 56° to be comfortable without air motion, caused me to go back to the tests made by Professor Shepherd from which the Comfort Zone Chart was constructed and superimpose the 56° wet-bulb curve on the line of comfort previously mentioned. It will be noted from the illustration (Fig. 3) that they are surprisingly similar. As the temperature increased, however, above 65°, the 56° wet-bulb curve passes several degrees above that of the average curve from the points noted by Professor Shepherd. It is extremely probable that the 56° wet-bulb approaches much closer to the condition of comfort than the average test curve, as it is a matter of common knowledge that a temperature of 71° with a relative humidity of 30% is not warm enough for comfort. The statement so frequently met with in the literature of the day, that flat dwellers keep their rooms too warm, is only an illustration of this fact. The relative humidity during the winter in apartments that are not humidified artificially is seldom above 30% and it is necessary to maintain a temperature of 74°, at least, under these conditions.

WHY THE WET-BULB TEMPERATURE IS THE DETERMINING FACTOR IN COMFORT.

The average wet-bulb without air motion in our tests is approximately 56° and I am satisfied that this point will be verified by future observations. The reason why the wet-bulb temperature is the determining factor in comfort of the subject I have tried to illustrate diagrammatically in Fig. 4. The curves are not based

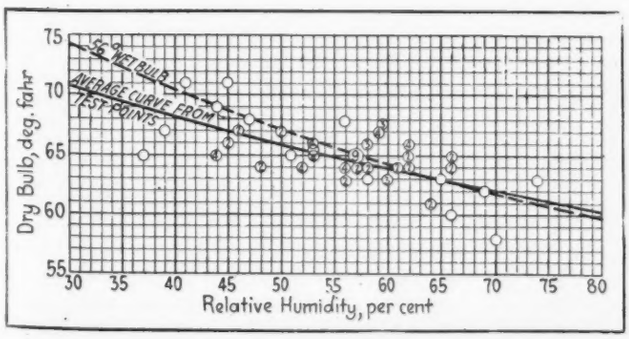


FIG. 3—CURVE OF COMFORT PLOTTED FROM PROF. SHEPHERD'S TESTS.

on any observations or tests, but are pure assumptions, although work is now under way at the Research Laboratories to determine them as accurately as possible.

At the bottom of the chart the variations in the dry-bulb and relative humidity are shown which maintains a constant wet-bulb of 56°. Curve "A" illustrates how heat loss by convection from the body is somewhere in the neighborhood of 425 B. T. U. per hour at an air temperature of 56°, but gradually decreases to zero when the surrounding air is the same temperature as that of the body. Curve "B" illustrates how the evaporation from the body both through the lungs and skin is somewhere in the neighborhood of 50 B. T. U. per hour at a temperature of 56° and how this increases to approximately 400 B. T. U. per hour at body temperature. "A" decreases as the temperature

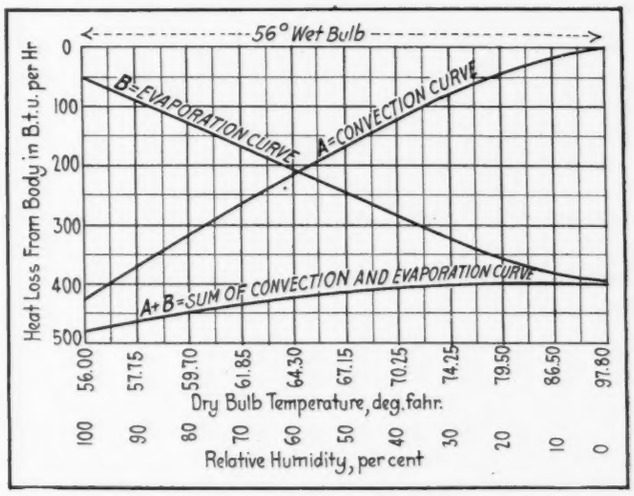


FIG. 4—EFFECT OF A CONSTANT WET-BULB TEMPERATURE ON COMFORT.

goes up and the relative humidity goes down; "B" increases under the same conditions, the sum of the two curves shown as curve "A"+"B" indicating a fairly constant heat loss under these varying conditions of temperature and relative humidity which maintain a constant wet-bulb of 56°.

PRINCIPLES EVOLVED, BASED ON PRESENT STATE OF THE ART.

From the foregoing it is evident that certain principles can be evolved that are of some value in clearing our conception regarding the influence of air conditions on comfort.

1—Comfort depends upon air conditions that allow the heat generated in the human body to be dissipated without the undue exercise of the heat regulating mechanism.

2—Heat losses from the body are inversely proportioned to the wet-bulb temperature, subject to the operation of the heat regulating mechanism.

3—The comfortable wet-bulb temperature varies directly with the air motion.

PRESENT STATUS OF THE SUBJECT.

After considering carefully the recent developments in the science of ventilation we must conclude that the old theory of poisonous substances in expired air must,

(*Continued on Page 49*)

Heating and Power Cost Analysis for Office Buildings

Based on Actual Figures Compiled During 1921 and Covering 150 Buildings Located in 47 Cities

EDITOR'S NOTE.—*Studies of engine-room costs are always difficult on account of the many different combinations and methods of purchasing power, and also because very few buildings keep any accurate distribution of power costs as applied to the power consuming department of the building. This, at least, is the experience of the committee of the National Association of Building Owners and Managers which has been engaged in analyzing these costs. Realizing, however, that the power costs of a building are one of its largest operating items, the committee asked each building to give such definite statistics as they had on the amount of power produced or consumed, or upon the amount of coal burned. From this information it has been possible to develop some conclusions as to heating and power costs which are published by the National Association of Building Owners and Managers and characterized as extremely interesting and valuable. The figures may well be studied in connection with the data published in* THE HEATING AND VENTILATING MAGAZINE *for July, 1922, on exhaust steam for heating.*

IN AN analysis of the heating power costs of some 150 office buildings, made by a committee representing the National Association of Building Owners and Managers, it was found that there are six general systems of producing or providing power for office buildings. These six systems fall into two main groups, according to whether the building has hydraulic or electric elevators. Each of these two groups is then divided into three sub-divisions:

1. Buildings buying both steam and electricity.
2. Buildings generating steam and buying electricity.
3. Buildings generating both steam and electricity.

According to this system of classification, the six general divisions obtained are as follows

Group 1. Buildings having electric elevators.

Type A.—Buildings *buying* steam for heating and *buying* electricity for elevators and lighting.

Type B.—Buildings *generating* steam for heating, and *buying* electricity for elevators and lighting.

Type C.—Buildings *generating* both steam and electricity.

Group 2.—Buildings having hydraulic elevators.

Type D.—Buildings *buying* steam for heating and hydraulic power and *buying* electricity.

TABLE 1—STEAM USED FOR HEATING ONLY—TYPE A PLANTS.

Bldg. No.	City	Sq. Ft.	1000 lbs. Steam	Lbs. Steam Per Sq.Ft.	Steam Cost	Cost Per 1000 lbs.	Cost Per sq. Ft.
138	Dayton	50,800	10,866	215	$5,368	$.494	$.105
17	Chicago	188,494	30,734	163	31,548	1.026	.167
42	Cleveland	109,598	16,773	153	13,242	.79	.121
41	"	146,000	18,749	128	13,814	.77	.095
114	West	35,000	4,500	128	5,315	1,10	.152
149	Peoria	44,000	5,424	123	2,892	.53	.067
65	Detroit	39,792	4,791	120	3,841	.80	.093
37	Cleveland	142,134	15,094	106	12,417	.80	.086
111	Spokane	66,957	7,074	106	5,564	.93	.086
79	Portland	62,069	6,450	104	5,065	.90	.081
67	Detroit	24,875	2,534	101	3,154	1.24	.127
47	Seattle	82,021	8,254	100	2,971	.36	.036
64	Detroit	275,000	25,757	100	29,114	1.13	.106
75	Portland	44,413	3,897	88	3,431	.88	.077
34	Cleveland	185,744	15,962	86	12,419	.778	.067
13	Chicago	378,942	32,398	85	31,632	.98	.083
40	Cleveland	290,000	22,326	77	18,400	.783	.063
70	Detroit	54,019	3,768	70	4,434	1.17	.082
51	Seattle	30,060	2,021	67	2,774	1.37	.092
45	"	257,034	16,804	65	6,049	.36	.024
78	Portland	80,612	5,162	64	4,052	.78	.050
29	San Fran.	55,200	3,072	56	3,032	.98	.055
53	Seattle	41,974	2,291	56	3,236	1,41	.077
44	"	378,775	18,765	50	17,848	.95	.047
49	"	74,100	3,720	50	6,283	1.69	.085
90	Indpls.	159,062	4,142	26	3,130	.75	.019
24	San Fran.	27,202	678	25	801	1.18	.029
	Total	3,323,877	292,006		$251,826		
	Average			88		$.86	$.076

TABLE 2—COAL USED FOR HEATIING ONLY—TYPE B PLANTS.

Bldg. No.	City	Sq. Ft.	Tons Coal	Lbs. Coal Per Sq. Ft.	Coal Cost	Cost Per Ton	Cost Per Sq. Ft.
140	Des Moines	57,808	1,150	39.6	$6,348.00	$5.52	.109
92	Indianapolis	105,525	1,598	30.3	9,425.00	5.89	.0391
69	Omaha	25,880	308	23.8	2,762.76	8.97	.108
115	Grand Rapids	33,481	391	23.7	3,315.68	8.48	.0992
129	Edm'ton, Can.	150,000	1,792	23.5	3,763.20	2.10	.025
125	Youngstown	42,601	483	23.0	2,898.00	6.00	.068
4	Chicago	164,000	1,867	22.7	12,844.96	6.88	.078
72	Omaha	113,845	1,277	22.5	9,717.97	7.61	.0854
2	Chicago	93,719	1,051	22.4	6,820.99	6.49	.0725
100	Denver	23,000	255	22.1	1,277.55	5.01	.0552
7	Chicago	183,800	1,940	21.1	12,610.00	6.50	.0689
141	Grand Rapids	50,000	503	20.1	3,772.50	7.50	.075
82	Boston	8,275	81	20.0	862.65	10.65	.105
8	Chicago	188,000	1,870	19.9	12,996.50	6.95	.069
74	Omaha	80,884	773	19.1	5,642.90	7.30	.0698
91	Indianapolis	144,036	1,315	18.2	7,114.15	5.41	.050
147	Columbia, S.C.	43,225	387	17.8	3,483.00	9.00	.080
113	Salt Lk. City	72,053	628	17.4	2,512.00	4.00	.0348
104	Cincinnati	105,000	890	17.0	5,117.50	5.75	.0487
71	Omaha	50,157	408	16.3	3,508.80	8.60	.070
109	North	51,532	413	16.2	2,787.75	6.75	.0541
146	Winston-Salem	57,888	450	15.5	3,150.00	7.00	.054
144	Louisville	114,263	875	15.3	4,593.75	5.25	.040
112	Spokane	119,330	870	14.9	7,830.00	9.00	.0657
83	Atlanta	70,000	476	13.6	2,813.16	5.91	.040
81	Boston	9,666	65	13.4	689.00	10.60	.072
121	Wash., D. C.	47,492	296	12.6	2,865.28	9.68	.060
137	Central	56,915	344	12.2	2,408.00	7.00	.042
1	Chicago	150,000	809	10.8	5,849.07	7.23	.0389
80	Boston	25,200	133	10.6	1,424.43	10.71	.056
89	Indianapolis	123,300	609	9.9	3,654.00	6.00	.029
135	Chattanooga	97,065	481	9.8	2,645.50	5.50	.027
56	New York	109,932	500	9.1	3,825.00	7.65	.0347
120	South	80,682	344	8.5	2,236.00	6.50	.0277
36	Cleveland	59,404	210	7.1	1,102.50	5.25	.0185
	Total	2,907,958	25,842		$164,867.55		
	Average			17.8		$6.38	.0567

TABLE 3—STEAM USED FOR HEATING AND HYDRAULIC ELEVATORS—TYPE D PLANTS.

Bldg. No.	City.	Sq. Ft.	1000 Lbs. Steam	Lbs. Steam Per Sq. Ft.	Steam Cost	Cost Per 1000 Lbs.	Cost Per Sq. Ft.
10	Chicago	51,199	10,610	211	$7,480	.73	.146
21	"	90,000	17,576	195	12,744	.73	.141
15	"	239,124	36,470	153	33,358	.91	.139
	Total	380,323	64,656		$53,582		
	Average			170		$.83	$.141

TABLE 4—COAL USED FOR HEATING AND HYDRAULIC ELEVATORS—TYPE E PLANTS.

Bldg. No.	City	Sq. Ft.	Tons Coal	Lbs. Coal Per Sq. Ft.	Coal Cost	Cost Per Ton	Cost Per Sq.Ft.
22	Chicago	73,700	2,223	60.2	15,561.00	$7.00	.211
18	"	66,547	1,985	60.1	13,239.95	6.67	.199
124	Pittsburgh	29,093	792	54.6	3,468.96	4.38	.1192
73	Omaha	101,000	2,520	50.0	20,586.40	8.17	.2038
5	Chicago	132,300	3,218	48.7	22,526.00	7.00	.170
108	Duluth	32,807	540	32.9	3,375.00	6.25	.1028
99	West	42,700	642	30.0	3,145.80	4.90	.0736
116	Grand Rapids	91,608	1,100	24.2	8,250.00	7.50	.0901
128	East	22,291	212	19.1	1,855.00	8.75	.0832
55	New York	136,926	679	10.0	4,311.65	6.35	.0315
143	Lincoln	45,546	200	8.6	1,700.00	8.50	.0351
	Total	774,518	14,111		$98,019.76		
	Average			36.4		$6.95	$.1265

TABLE 5—COAL USED FOR HEATING AND GENERATING ELECTRICITY FOR ELECTRIC ELEVATORS AND LIGHTING—TYPE C PLANTS.

Bldg. No.	City	Sq. Ft.	1000 lbs. Steam	Lbs. Steam Per Sq. Ft.	Steam Cost	Cost Per 1000 lbs.	Cost Per sq. Ft.
68	Detroit	140,736	3530	50.4	24,109.90	6.83	.17
107	Duluth	59,360	810	27.3	3,807.00	4.70	.064
	Total	200,096	4340		27,916.90		
	Average			43.4		$6.43	.139

TABLE 6—COAL USED FOR HEATING AND HYDRAULIC ELEVATORS AND GENERATING ELECTRICITY FOR LIGHTING—TYPE F PLANTS.

Bldg. No.	City	Sq. Ft.	Tons Coal	Lbs. Coal Per Sq. Ft.	Coal Cost	Cost Per Ton	Cost Per Sq. Ft.
105	Duluth	41,000	1900	92.6	$11,001.00	5.79	.27
66	Detroit	75,860	3122	82.4	19,387.62	6.21	.25
11	Chicago	463,804	16050	69.4	96,300.00	6.00	.20
20	"	150,000	5000	66.6	30,000.00	6.00	.20
103	Cincinnati	68,975	1867	54.2	11,202.00	6.00	.16
14	Chicago	145,545	3765	51.5	28,086.90	7.46	.192
133	Scranton	43,000	998	46.5	4,990.00	5.00	.11
127	Eastern	117.739	2374	40.3	17,615.00	7.42	.15
16	Chicago	120,935	2161	35.8	14,262.60	6.60	.116
	Total	1,226,858	37,237		$232,845.12		
	Average			60.7		$6.25	.189

Type E.—Buildings *generating* steam for heating and hydraulic power and *buying* electricity.

Type F.—Buildings *generating* steam for heating and hydraulic power and also *generating* electricity.

In addition to the above distinct classifications, there are a few combinations of the above or unusual variations therefrom, such, for instance, as plants that generate their own electricity in the winter time and buy it from central station in the summer. One plant also reported a hydraulic elevator installation operated by electric-driven pumps. There are so few of these variations from the above classification, that they have been omitted from this power cost analysis.

When the various statements are grouped in accordance with the above classification of their power production, it was then possible to determine the following information:

1. The pounds of steam per square foot used for heating only in Type A buildings.
2. The pounds of coal per square foot used for heating only in Type B buildings.
3. The pounds of steam per square foot for heating and hydraulic elevators in Type E plants.
4. The pounds of coal per square foot for heating and hydraulic elevators in Type E plants.
5. The pounds of coal per square foot for heating and generating electricity for electric elevators and lights in Type C plants.
6. The pounds of coal per square foot for heating and hydraulic elevators in Type F plants.
7. The K. W. H. per square foot for lighting only, as given in the Type D and E plants.
8. The K. W. H. per square foot for electricity for elevators and lighting in the Class A and B plants.

The figures from which the eight principal items described above are obtained are given in detail in the report. Those bearing on the heating load are presented herewith. In these tables the buildings have been grouped in the order of the quantity of power, steam or coal consumed per square foot.

It will be observed that because of the failure of the buildings generating steam for both heating and hydraulic elevators, or for heating and the operation of electric generators, to determine the amounts required for heating as separated from the power use, no figures are shown for either the coal or steam necessary to operate hydraulic elevators or generators independent of the heating load of the building.

TABLE 7—SUMMARY OF POWER CONSUMPTION, RATES, AND COSTS PER SQUARE FOOT.

Table No.	Type	Kind of Power	Units per Sq. Ft.	Rate, Cents per Unit.	Cost, Cents per Sq. Ft.
1	A	Steam for heating only	88 lbs.	0.086	7.60
2	B	Coal for heating only	17.8 lbs.	,319	5.67
3	D	Steam for heating and hydraulic elevators	170 lbs.	.083	14.10
4	E	Coal for heating and hydraulic elevators	36.4 lbs.	0.347	12.65
5	C	Coal for heating, electric elevators and light	43.4 lbs.	.321	13.90
6	F	Coal for heating, hydraulic elevators and electric light	60.7 lbs.	.313	18.90
7	E	Electricity for light only	2.04 K. W. H.	.030	6.12
8	D	Electricity for light only	1.15 K. W. H.	.025	2.78
9	A	Electricity for light and elevators	2.77 K. W. H.	.023	6.50
10	B	Electricity for light and elevators	1.88 K. W. H.	.030	5.60
Average Groups E and D electricity for light only			1.65 K. W. H.	.029	4.62
Average Groups A and B electricity for light and elevators			2.35 K. W. H.	.0257	6.05

Constructive Mechanism and the Centrifugal Fan

Points to Be Considered in the Design of an Apparatus Capable of Meeting Given Requirements

BY GEORGE D. BEALS,

Massachusetts Blower Company.

THE difficulty sometimes encountered by the designer in analyzing a problem in machine design for the purpose of applying the correct formulae is undoubtedly due to a lack of the full realization of the practical value of the principles of physics and mechanics and their application to actual constructions. As the satisfactory operation and lasting life of any machine is based upon the fundamental laws of physics and mechanics, the designer's understanding of these fundamentals must be sufficient to enable him to deduce the rational formulae he finds necessary, as well as to form a sound opinion of the reliability of the empirical rules given in engineering handbooks and the numerous engineering publications.

It is true that if, while a student, he meets some of the complicated details of actual design and has the guidance of a capable and careful teacher, he will obtain a satisfactory understanding of the subject in hand, and one of great help in practical work. The great number of universities throughout the country, the day and evening technical schools in every city, and the vast amount of literature upon mechanical subjects, give every advantage for those interested to gain this valuable education.

For those men who have not received a training in the subject of constructive mechanism the writer trusts that the following brief discussion of these principles, as applied to the centrifugal fan, will prove timely. In this discussion we shall not make a comprehensive mathematical study, nor go into textbook details of the different subjects, but shall simply concern ourselves with some of the most important facts and formulae under the various headings and shall work an illustrative example of each.

Throughout the article we shall use as an example in the application of these principles, a fan of the multi-bladed type having a wheel 48 in. in diameter. We shall assume this unit to be handling 44,750 cu. ft. of air per minute under standard conditions and against a static resistance of 2½ in. water gauge, for which duty we will further assume that the fan must run at a speed of 415 revolutions per minute, peripheral velocity 5215 ft. per minute and require a 50 horse-power motor for driving.

WHEEL

Side Bands.—Side bands are usually designed with sufficient strength and rigidity to be self-supporting. If we consider a rotating wheel with the spider removed as a free ring (*i. e.* without arm restraint on the driving floats) the tensile stress in the side bands, due to centrifugal force, may be determined by the use of the formula:

$$S = 0.00005427\ WRN^2$$

S = Tensile stress, lbs.
W = Total weight of wheel, neglecting spider, lbs.
R = Radius of gyration, ft.
N = Number of revolutions per minute.

The stress intensity, due to centrifugal force, in pounds per square inch, may be stated as,

$$f_t = \frac{S}{a}$$

f_t = stress intensity in side band, lbs. per sq. in.
a = cross sectional area of side band with necessary deductions for rivet holes, sq. in.
f_t for steel plate must not exceed 16,000 lbs. per sq. in.

When a side band is made up in segments, as is the usual practice on certain types of wheels, the riveted joint must be made strong enough to safely withstand the strain S. Rivets must be chosen of size and number to resist failure by shear and to afford such bearing surface as to prevent distortion of the metal at the rivet holes. The number of rivets necessary to give sufficient strength to the joint to resist the load S may be found by the formulae:

$$R_s = \frac{S}{V_s} \text{ and } R_c = \frac{S}{V_b}$$

R_s = Number of rivets required to resist shear.
R_c = Number of rivets required for bearing value or to resist crushing of the plate.
V_s = Shearing value of the rivets, lbs.
V_b = Bearing value of the plate, lbs.

The quantities V_s and V_b are found in tables giving the shearing and bearing values for rivets and plates as contained in Carnegie's "Pocket Companion," "Cambria Steel" and other handbooks. The allowable shearing stress for rivet steel may be taken as 6000 lbs. per square inch and the bearing value of the plates as 10,000 lbs. per square inch.

As an aid to the selection of the proper rivet diameter the following relation between thickness of plate and diameter of rivet is suggested:

Thickness of plate, inches	1/8	3/16	1/4	5/16	3/8	7/16	1/2
Diameter of rivet, inches	3/8	7/16	1/2	9/16	5/8	11/16	3/4

Example:

$W = 290$ lbs.
$N = 415$ r. p. m.
$R = 1.875$ ft.
$a = 0.586$ sq. in.
$S = 0.00005427 \times 290 \times 1.875 \times 415^2 = 5082$ lbs.

$$f_t = \frac{5082}{0.586} = 8{,}675 \text{ lbs. per square inch.}$$

Thickness of side bands = 3/16 in.
Use 7/16-in. rivets.

V_s = area of rivet, sq. in. x 6,000 = 900 lbs. per sq. in.
V_b = dia. of rivet, in. x thickness of plate, in. x 10,000 = 820 lbs. per square inch.

$$R_s = \frac{5082}{900} = 5.65 \text{ rivets}$$

$$R_c = \frac{5082}{820} = 6.2 \text{ rivets}$$

In this case it would be safe enough to use six 7/16-in. rivets at each lap.

Blades—Most of the stress in the blades of a fan wheel is due to centrifugal force caused by the weight of the blade itself. This force acts in a radial direction and is usually considered to be uniformly distributed across the length of the blade. It is evident from this that a straight radial blade is the strongest, while the strength of a curved blade depends solely upon its curvature.

The centrifugal force on a blade may be established by the use of the formula:

$$C_f = 0.000341\ WRN^2$$

C_f = Centrifugal force, pounds
W = Weight of blade, pounds
R = Radius of gyration, feet
N = R. P. M.

The radius of gyration is the distance from the axis of rotation to that point at which the total weight of the blade may be assumed to be concentrated, or the center of gravity of the blade. This center of gravity may or may not lie within the area of the blade but it always lies in the neutral axis, or in the axis of symmetry, if there is one.

Except in connection with fan work of very high speeds it will be found that the rivets which are required to hold the float rigidly in place will furnish more than enough strength to resist the action of centrifugal force. The method of determining the size and number of rivets necessary to counteract this action is found in a similar manner to that described under "Side Bands."

The moment of inertia of the blade is equal to:

$$I = AR^2$$

I = Moment of inertia, inches^4
A = Sectional area of blades, square inches.
R = Radius of gyration, inches.

The value of the resisting moment of the blade may be determined by the formula:

$$M_r = \frac{fI}{c}$$

M_r = Resisting moment, inch pounds.
c = Distance from the center of gravity to the most extreme fiber, inches.
f = Safe fiber stress = 16,000 lbs. per square inch for steel.

The greatest, or maximum bending moment, is determined by the use of the formula:

$$M_b = \frac{C_f\ L}{8}$$

M_b = Max. bending moment, inch pounds.
L = Length of longest span, inches.

So long as the maximum bending moment, as found above, does not exceed the result for resisting moment the float is safe, or

M_r must exceed M_b for safety.

The driving effort exerted by the spider arms place another force upon the main or driving floats which, however, is generally so small that it can be neglected. Stated in word form, the force exerted by each arm is equal to the horsepower in foot-pounds per minute divided by the peripheral velocity in feet per minute times the number of arms.

The stresses set up in the blades of wheels, other than those having a high peripheral velocity, are so small that it is usually unnecessary to figure them. Materials of sufficient strength to provide staunchness and rigidity to the structure will prove much stronger than is really necessary to resist the external forces.

Spider Arms—For purpose of design the spider arms are ordinarily treated as cantilevers and each is assumed to carry its proportional part of the load.

The thrust, or load on each arm is found as follows:

$$T = \frac{M_t}{r}$$

T = Thrust, inch pounds.
M_t = Twisting moment on each arm, inch pounds.
r = Distance from center of shaft to center of gravity of float, inches.

$$M_t = \frac{12 \times 33000 \times \text{H.P.}}{2\pi \times \text{R.P.M.} \times n} = \frac{63024 \times \text{H.P.}}{\text{R.P.M.} \times n}$$

n = number of spider arms.

The bending moment on each arm at the hub is equal to:

$$M_b = T \times L$$

M_b = Bending moment, inch pounds.
L = Distance from center of gravity of float to edge of hub, inches.

The bending moment at any point along the arm may be found by the use of the foregoing formula where L is taken as the distance from the center of gravity of the float to the given point.

The fiber stress in the arm due to bending action is obtained by the use of the formulae:

$$f_1 = \frac{M_b\ c}{I} \text{ or } f_1 = \frac{M_b}{S}$$

f_1 = Fiber stress, lbs. per square inch.
c = Distance from neutral axis to the most extreme fiber, inches.
I = Mom. of inertia of section about neutral axis, inches^4.

$$S = \text{Section modulus} = \frac{I}{c}$$

The fiber stress in the arm due to centrifugal force must next be found.

$C_f = 0.000341\ WRN^2$

C_f = Centrifugal force, pounds.
R = Radius of gyration, feet.
N = R. P. M.
W = Weight of one arm plus the weight of one float divided by the number of hubs.

The fiber stress due to centrifugal force is equal to:

$$f_2 = \frac{C_f}{a}$$

f_2 = Fiber stress, lbs. per square inch.
a = Sectional area of arm, square inch.

The total fiber stress in the arm, in pounds per square inch, is then equal to $f_1 + f_2 = F$. The safe value of F for various materials is as follows:

16,000 lbs. per square inch for steel
6,000 " " " " " cast-iron
9,000 " " " " " wrought-iron
6,000 " " " " " malleable-iron
6,000 " " " " " brass composition
8,000 " " " " " phosphor bronze

Example:

H.P. = 50
R.P.M. = 415
n = 6

$$M_t = \frac{63024 \times 50}{415 \times 6} = 1265 \text{ inch pounds.}$$

$$T = \frac{1265}{22.5} = 56.22 \text{ inch pounds.}$$

$M_b = 56.22 \times 20$ inch $= 1125$ inch pounds.

Try spider 2¼ in. x 2¼ in. x ¼ in. tee arms.

$$f_1 = \frac{1125}{0.32} = 3516 \text{ lbs. per square inch.}$$

$C_f = 0.000341 \times 16.6 \times 1.875 \times 415^2 = 1828$ lbs.

$$f_2 = \frac{1828}{1.19} = 1537 \text{ lbs. per square inch.}$$

$F = f_1 + f_2 = 3516 + 1537 = 5053$ lbs. per square inch.

Spider arms O. K. and yield good factor of safety.

BELT CALCULATIONS.

Force Acting on Fan Shaft due to Belt Tensions.

V_b = Belt velocity, feet per minute $= \pi DN$
D = Diameter fan pulley, feet.
N = R. P. M. fan pulley.
R_t = force due to belt tensions, pounds $= T_1 + T_2$
T_1 = Tension in tight side of belt, pounds

$$= \frac{\text{H.P.} \times 57750}{V_b}$$

T_2 = Tension in slack side of belt, pounds $= 3/7\ T_1$

The above formulae do not express the actual tensions in the belt since they fail to take into account the effect of centrifugal force due to the weight of the belt itself. This centrifugal force tends to throw the belt away from the pulley and thereby to increase the belt tension to an amount above the net tensions necessary for transmitting the horsepower.

t = Tension due to centrifugal force, pounds $= \frac{w v^2}{g}$

w = Weight of belt per unit of length, which may be taken as 0.15 lbs. for a section of double leather belt 1 in. wide and 12 in. long.
v = Belt velocity, feet per second.
g = Acceleration due to gravity, feet per second^2 = 32.2

To allow for the effect of centrifugal force the formula expressing the ratio of tensions necessary to transmit a given horsepower becomes:

$$\frac{T_1 - t}{T_2 - t} = \frac{7}{3}$$

As the tension due to centrifugal force is small except on very high belt speeds this item is usually neglected in practical fan work.

Example:

$V_b = \pi \times 3 \times 415 = 3912$ ft. per minute.

$$T_1 = \frac{50 \times 57750}{3912} = 738 \text{ lbs.}$$

$$\frac{738}{T_2} = \frac{7}{3} \therefore T_2 = 316 \text{ lbs.}$$

$R_t = 738 + 316 = 1054$ lbs.

If the tension due to centrifugal force had been taken into consideration, R_t would have become 1066 lbs., a negligible difference in this case.

Width of Belt.—The maximum allowable tension per inch of width may be taken as 140 lbs. for double leather belt and 75 lbs. for single leather belt, assuming that stresses due to centrifugal force are neglected.

Then $\frac{T_1}{T_2} = \frac{7}{3}$ and $T_1 = 140$ lbs. per inch of width.

$\therefore T_1 - T_2 = 80$ lbs.
= maximum effective pull per inch of width of double belt.

Also $\frac{T_1}{T_2} = \frac{7}{3}$ and $T_1 =$ lbs. per inch of width.

$\therefore \quad T_1 - T_2 = 42.86$ lbs.
= maximum effective pull per inch of width of single belt.

$$\text{Width of double belt inches} = \frac{33000 \times \text{H.P.}}{V_b \times 80} = 413\frac{\text{H.P.}}{V_b}$$

$$\text{Width of single belt, inches} = \frac{33000 \times \text{H.P.}}{V_b \times 42.86} = 770\frac{\text{H.P.}}{V_b}$$

Example:

$$\text{Single belt} = 770 \times \frac{50}{3912} = 9.86 \text{ in. wide}$$

$$\text{Double belt} = 413 \times \frac{50}{3912} = 5.29 \text{ in. wide}$$

Use 6-in. double belt.

SHAFT.

Calculation of Shaft with Overhung Pulley.

R_t = Force due to belt tensions, pounds.
W_p = Weight of pulley, pounds.
R_w = Resultant force acting on shaft, pounds.

This force, R_w, may be determined graphically close enough for all practical work, or can be found analytically by the use of the following formulae:

(1) $R_w = \sqrt{\left(R_t\right)^2 + \left(W_p\right)^2}$ when forces R_t and W_p act 90° apart.

(2) $R_w = \sqrt{\left(R_t\right)^2 + \left(W_p\right)^2 - 2R_tW_p \cos (180° - \Phi)}$

when forces R_t and W_p act more than 90° apart.

(3) $R_w = \sqrt{\left(R_t\right)^2 + \left(W_p\right)^2 + 2\,R_t\,W_p \cos (180° - \Phi)}$

when forces R_t and W_p act less than 90° apart.

F = total deflection of shaft due to load, inches. For a cantilever beam, $F = \frac{R_wL^3}{3EI} + \frac{W_sL^3}{8EI}$

Ordinarily the deflection due to the weight of a length of shaft necessary to accommodate an overhung pulley drive is so small in comparison to that caused by the weight of the pulley and the force

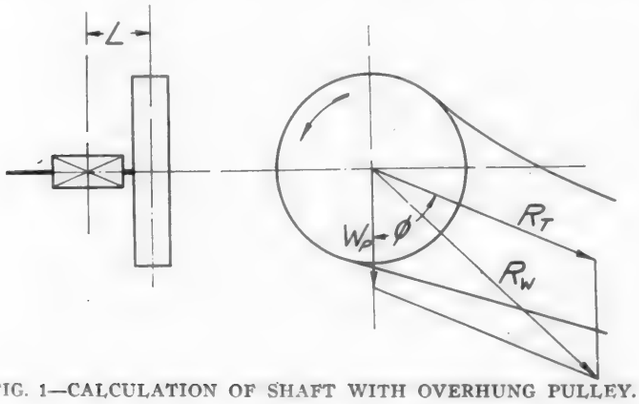


FIG. 1—CALCULATION OF SHAFT WITH OVERHUNG PULLEY.

exerted by the belt pull that, W_s, the weight of the shaft, is added to the resultant force, R_w, and the total deflection taken as equal to:

$$F = \frac{(R_w + W_s)\ L^3}{3\ EI}$$

L = Span in inches.
E = Modulus of elasticity = 29,000,000 lbs. per sq. in.
I = Transverse moment of inertia, inches^4 = $\frac{\pi r^4}{4}$
W_s = Weight of shaft, lbs.
r = Radius of shaft, inches.

It is considered good practice to limit the deflection of fan shafts to 0.01 in. per foot, total deflection not to exceed 0.06 in.

Example:

Referring to Fig. 1, let angle $\phi = 60°$
In this case formula 3 would apply in the solution of the resultant force acting on the shaft.

R_t = 1054 lbs.
W_p = 190 lbs.
W_s = 21.7 lbs.
$R_w = \sqrt{(1054)^2 + (190)^2 + 2 \times 1054 \times 190 \times \cos (180°-60°)}$
= 1161 lbs.
L = 10½ in.
I = 2.561 in.^{4} for $2\frac{11}{16}$ in. shaft, neglecting keyway.

$$F = \frac{(1161 + 21.7) \times 10.5^3}{3 \times 29{,}000{,}000 \times 2.561} = 0.00615 \text{ in.}$$

$$\text{Deflection per foot} = \frac{0.00615 \times 12}{10.5} = 0.007 \text{ in.}$$

If the deflection had exceeded the maximum allowable, it would have become necessary to choose a larger shaft and refigure the deflection. There are some very good charts in various handbooks from which the proper size of shaft to support any load may be chosen direct, eliminating all laborious calculations.

Deflection due to Weight of Wheel.

Case 1. Wheel overhung on fan shaft.

$$F_{max} = \frac{W_wL^3}{3EI} + \frac{W_sL^3}{8EI}$$

W_w = Total weight of wheel.

Case 2. Wheel supported centrally between two bearings.

$$F_{max} = \frac{W_wL^3}{48EI} + \frac{5\,W_sL^3}{384EI}$$

Case 3. Wheel supported at two points symmetrically between two bearings.

$$F_{max.} = \frac{W_w\ a}{12\ EI}\left(0.75\ L^2 - a^2\right) + \frac{5\ W_s\ L^3}{384\ EI}$$

Case 4. Wheel supported at one point unsymmetrically between two bearings.

$$F_{max.} = \frac{W_w\ ab\ (a + 2b)\ \sqrt{3a(a + 2b)}}{27\ EIL} + \frac{5\ W_s\ L^4}{384\ EI}$$

When calculating the static deflection of a shaft due to the weight of the wheel, it may be advisable to take into consideration the weight of the shaft and to treat it as a uniformly distributed load. However, if extreme refinement is not desired, the total weight of the shaft may be added to the weight of the wheel, and the latter part of each of the above formulae dropped off.

All deflection formulae given apply to shafts of a uniform diameter. The deflection of a bossed shaft, such as commonly used for double-width machines, can be determined only by resort to calculus. For ordinary work an approximation can be made in this case by the use of these formulae, although the results may be as much in error as 20%.

Example:

As an example for the title we shall illustrate Case 2.

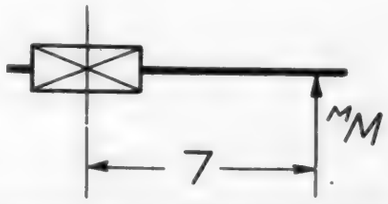


FIG. 2—DEFLECTION DUE TO WEIGHT OF WHEEL OVERHUNG ON FAN SHAFT.

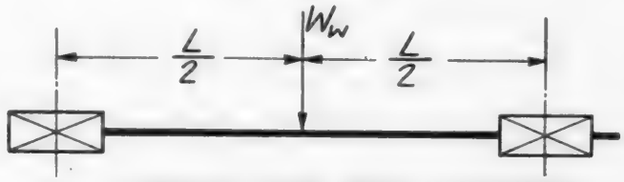


FIG. 3—CONDITION WHEN WHEEL IS SUPPORTED CENTRALLY BETWEEN TWO BEARINGS.

$W_w = 375$ lbs.
$W_s = 67.5$ lbs.
$L = 42$ in.

$$F_{max} = \frac{375 \times 42^3}{48 \times 29{,}000{,}000 \times 2.561} + \frac{5 \times 67.5 \times 42^3}{384 \times 29{,}000{,}000 \times 2.561} =$$

$0.0078 + 0.0009 = 0.0087$ in. total deflection.

$$\text{Deflection per foot} = \frac{0.0087 \times 12}{42} = 0.0025 \text{ in.}$$

It might here be interesting to note that the stress intensity in the fibers of a shaft subject to bending action is zero at the neutral fiber, or center-line, and increase uniformly to maximum intensities in compression or tension at the top and bottom of the shaft, depending upon the method of loading and support of the shaft. It is evident that the extreme fibers of the shaft change from the maximum intensity in compression to the maximum intensity in tension during each revolution.

Calculation of Critical Speed.—Reports on exhaustive treatments of this subject, together with many of the formulae developed may be found in the various engineers' handbooks. The general formula for a single concentrated load, which formula applies for either an overhung shaft or a shaft supported near the ends, is given as

$$N = 187.7\sqrt{\frac{1}{F}}$$

N = Critical speed in R.P.M.
F = Maximum static deflection of the shaft, inches.

Unless greater accuracy is desired this formula may ordinarily be used for two concentrated loads or uniformly distributed loads although the developed formulae for these cases may be found in most handbooks.

The safe operating speed may be taken as two-thirds of the critical speed as found above.

Example:

$F = 0.0087$ in.

$$N = 187.7\sqrt{\frac{1}{0.0087}} = 187.7 \times 10.72 = 2012 \text{ r. p. m.}$$

Safe operating speed $= 2012 \times 0.66 = 1328$ r. p. m.

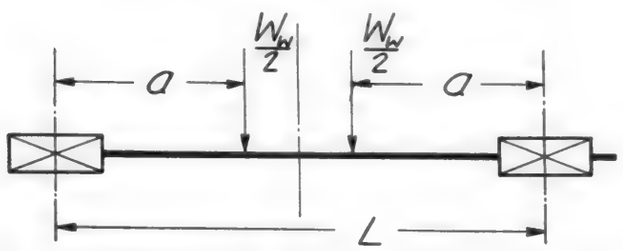


FIG. 4—CONDITION WHEN WHEEL IS SUPPORTED AT TWO POINTS SYMMETRICALLY BETWEEN TWO BEARINGS.

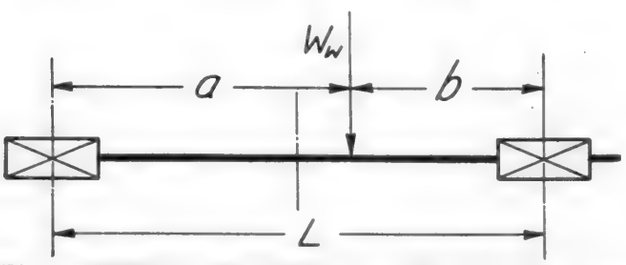


FIG. 5—CONDITION WHEN WHEEL IS SUPPORTED AT ONE POINT UNSYMMETRICALLY BETWEEN TWO POINTS.

KEY.

Calculation of Key in Driving Pulley:

M_t = Twisting moment on shaft, inch pounds.

$$= \frac{12 \times 33000 \times \text{H.P.}}{2\pi \text{ R.P.M.}} = 63024 \frac{\text{H.P.}}{\text{R.P.M.}}$$

T_k = Thrust on key inch pounds $= \frac{M_t}{r}$

r = Radius of shaft, inches.

For good design the crushing and shearing values of the key, with proper factors of safety, must be equal to or exceed the thrust on same, or

$$T_k \leqq \frac{f_s \, w \, l}{\text{F. S.}} \text{ for shearing.}$$

F.S. not less than 5

$$T_k \leqq \frac{f_c \frac{t}{2} l}{\text{F. S.}} \text{ for crushing.}$$

F.S. not less than 4.
f_s = Shearing strength of key, pounds per square inch.
f_c = Crushing strength of weaker material; key, shaft, or pulley hub, pounds per square inch.
t = Thickness of key, inches.
w = Width of key, inches.
l = Length of key, inches.

The standard drawing room practice of several companies is to proportion keys approximately in accordance with the following empirical formulae:

$$w = \frac{d}{4} \text{ and } t = \frac{d}{5}$$

where, d = diameter of shaft, inches.

These rules give a good margin of strength for both shearing and crushing in all ordinary cases.

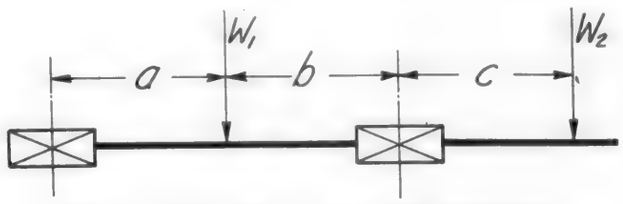


FIG. 6—CALCULATION OF BEARING PRESSURES.

Example:

Steel key 5/8 in. x 1/2 in. x 5 1/2 in.

$$M_t = 63024 \times \frac{50}{415} = 7595 \text{ inch pounds.}$$

$$T_k = \frac{7595}{1.34375} = 5660 \text{ inch pounds.}$$

$f_s = 50000$ lbs. per square inch.
f_c for key and shaft $= 75000$ lbs. per square inch.
f_c for pulley hub $= 85000$ lbs. square inch.
t = 0.5 in.
w = 0.625 in.
l = 5.5 in.

$$T_k \text{ for shearing} = \frac{50{,}000 \times 0.625 \times 5.5}{5} = 34{,}375 \text{ in. lbs.}$$

$$T_k \text{ for crushing} = \frac{75{,}000 \times \frac{0.5}{2} \times 5.5}{4} = 25{,}780 \text{ in. lbs.}$$

Key found O. K. for both shearing and crushing.

BEARINGS.

Calculation of Bearing Pressures.—Two general types of fan bearings now commonly used are the self-aligning and the rigid pillow block. The proportions of these bearings are usually arbitrarily chosen, being based on the judgment and experience of the designer.

Under ordinary conditions of operation the allowable bearing pressure for fan duty may be taken from 50 to 80 lbs. per square inch of projected area; the projected area being that surface found by multiplying the diameter of the shaft by the actual length of the bearing.

$$R_b = \frac{W_1 \times a}{(a+b)} + \frac{W_2 \times (a+b+c)}{(a+b)}$$

R_b = Maximum resultant force on bearing, pounds. Either W_1 or W_2 may be the resultant force, pounds, due to belt tensions, weight of pulley, and the weight of the overhung shaft, or, the resultant force due to the weight of the wheel and supporting shaft, depending upon the arrangement of the apparatus, whether overhung pulley or overhung wheel.

$$P_b = \frac{R_b}{D \times L}$$

P_b = Bearing pressure, pounds per square inch of projected area.
D = Diameter shaft, inches.
L = Actual length of bearing, inches.

Example:

$W_1 = 443$ lbs.
$W_2 = 1183$ lbs.
$L = 13$ in.
$D = 2\ 11/16$ in.
$a = 21$ in.
$b = 21$ in.
$c = 10\frac{1}{2}$ in.

$$R_b = \frac{443 \times 21}{42} + \frac{1183 \times 52.5}{42} = 1700 \text{ lbs.}$$

$$P_b = \frac{1700}{2.6875 \times 13} = 48.6 \text{ lbs. per square inch of projected area.}$$

Allowable, 80 lbs. per square inch of projected area.

Squeezing the Waste Out of Industry

A notable year for the Bureau of Standards is reported by the director of the bureau, due largely to the great amount of scientific attention which has been given to the problem of eliminating industrial wastes. The bureau has acted as a clearing house on this subject, its staff having assisted in preparing a number of codes and specifications. It has also conducted a large number of important investigations in its laboratories to eliminate unnecessary waste. A few of the investigations are the following:

Large sums are lost each year through the corrosion of underground pipes, conduits, and metal structures. Part of this is the result of electrolytic action while part is caused by conditions of the soil. The bureau has mapped out an extensive program to study this subject, and, if possible, to suggest means for preventing this waste. Pieces of pipe have been buried in different sections of the country, and the effect of the soil in these localities on the metal will be studied.

Most appliances used for heating by gas are operated at very low efficiency, with a consequent waste of gas and also with a very bad effect on persons working in the same room, through imperfect combustion. The bureau has studied the subject of improving both natural and artificial gas burners very thoroughly and has already issued recommendations which will greatly reduce gas consumption and improve the health of the users.

In the field of building construction more material than is necessary is often used for a wall, column, or floor slab, because information concerning the stresses which such structures or members can safely bear, their ability to resist fire, etc., is inaccurate or incomplete. In order to more definitely formulate safe and economical standards in this field, the bureau is investigating the suitability of rerolled steel as a reenforcement for concrete, the strength of walls and floors, the resistance of buildings to fire, and the constitution of cement and concrete.

Two new divisions have been added during the year. The first is the Division of Building and Housing while the second is that of Simplified Practice. The housing situation is of vital importance to everyone and the bureau has endeavored during the year to aid in supplying the American people with more and better homes. Valuable statistics covering cost of building materials all over the country, percentage of home ownership in various cities, etc., have been issued at regular intervals and sent to a large mailing list. In cooperation with the cement section the present status of the concrete housing industry has been investigated. A "Zoning Primer" was issued giving the main points to be kept in mind when framing ordinances governing this important development in municipal regulation. In cooperation with other divisions of the bureau, good progress has been made in the preparation of a plumbing code.

The Division of Simplified Practice is working in close cooperation with American industries to eliminate useless sizes of the commonly-used industrial products and is directing the attention of manufacturers to the advantages of concentrating on the sizes and types in greatest demand.

A considerable portion of the time of some of the divisions has been given to assisting the Federal Specifications Board, created by the Bureau of the Budget and of which the Director of the Bureau of Standards is Chairman, in the formulation of specifications for the various government departments. Twenty-five of these specifications were issued during the year and their use will result in considerable savings, as well as simplifying government purchases.

As in the newer work, so also in the older established lines of activity, a great deal of attention has been paid to the practical application of scientific work, and often the solution of an apparently abstract scientific problem will turn out to be of real value in some line of industry.

The results of the Bureau's work are made available through its publications, of which 67 were issued during the fiscal year. These are all listed in Circular 24 of the bureau which not only gives the title of every publication prepared by the Bureau of Standards, but also a complete abstract, so that any one can pick out the papers which will be of the greatest benefit to them. This circular, together with any of the other publications of the bureau, may be obtained from the Superintendent of Documents, Government Printing Office, Washington.

Space Requirements for Mechanical Equipment

The Amount and Location of Quarters Usually Available for the Various Utilities and the Form of Building Construction that Will Facilitate Their Installation

BY H. L. CLUTE

(*Concluded*)

At the tops of the buildings pipes are placed in several locations. The furring of a roof corresponds very closely to the furring of an intermediate ceiling. The pipes are carried under the roof and furred in. They are then inaccessible. If there is an attic space, it is very desirable to use this for the mains. By attic space is meant a space 3 or 4 ft. high, with a working floor permitting access. Very often systems of distribution are used where steam, hot and cold water, and drinking water are carried in such spaces.

Another location is in a raceway on the roof around the parapet walls. A space 3 or 4 ft. wide is built on concrete or tile walls, high enough to permit the placing of pipes, and roofed over in some suitable manner. The steam mains are carried in this space and the water mains may be carried there also, as the heat from the steam piping will prevent the water from freezing. The steam risers are then carried directly down in the outside walls. The plumbing risers and water supply pipes have to be offset on the top floor ceiling which is easy to provide for.

DISPOSAL OF THE TRUNK RISERS.

Trunk risers include those for steam, cold water for house tank, main from the house tank back, piping from the blow-out and several other pipes that are carried from the boiler-room. A lowest room pipe shaft of ample size should be provided for this and is usually allowed for. It should be wide enough to permit access, about 3 ft. 6 in., if it is long enough to accommodate all the pipes in one layer. This shaft is usually placed alongside the smoke-stack. A very good arrangement is to use a beam or girder of the size of the smoke-stack for a walkway in the shaft, building a shaft over that sufficiently large to accommodate the pipes.

The steam risers are near the outside walls of the building, in every case. Plumbing risers are almost always at the interior of the building. Refrigerating risers may be located at any point, they have no definite place.

Risers at the outside walls may be exposed, they may be furred in with the columns or they may be carried up in chases. With the skeleton construction it is usually difficult to provide chases, although there is a form of construction in which the span of the beam is thinner by 4 in. than the thickness of the wall, that is, the inside face of the span of the beam sets back from the inside face of the wall about 4 in. This permits a chase 4 in. deep being carried up through the skeleton-constructed building and it is a very fine place to conceal steam risers.

Many of the better class of buildings nowadays are having these pipes concealed, and no doubt the time will come when nothing but loft buildings and factories and some of the rougher kinds of buildings will be constructed with exposed piping.

When the risers are furnished in the columns, there is no special provision except that the spandrel beam sometimes extends to the inner face of the column, and there is difficulty in placing the risers where they may be furred in.

INTERIOR PIPE SHAFTS.

In the interior of a building risers are placed in shafts, sometimes easily accessible and sometimes not. In hotels, for instance, pipe shafts are usually provided with space for the pipes and for access for maintaining them. Two feet, four inches is about the minimum width that should be allowed; the length varies from 3 to 6 ft. Sometimes each floor is filled in around the pipes and a separate sheet metal ventilating duct is carried up in each shaft for ventilating the bathrooms. If the floors are open, steel doors are required at each opening for access; that is a fireproof construction requirement. If the doors are closed, ordinary wood panels may be provided. If they are left open, of course, the entire area has to be framed, whereas with the closed shaft the pipes may be carried up through the sleeves between the reinforcing rods; no special beams or provisions have to be made. It is always a question as to which type should be used.

If the pipes or risers are placed in special non-accessible shafts they are either at the columns or in special locations as may be found here and there. If they are at the columns there is an objection to the amount of space required. There is always a beam carried out from the center of the column, leaving the only available space for pipes at the side—one side usually—of this beam, so that two-thirds of the space taken is not available for pipes; that is two-thirds of the added size of columns is vacant space because of this beam. If there could be some way of designing the beams, where there are a number of shafts of this kind, as is the case in office buildings, with two separate beams, one on each side of the column, so that the extra space enclosed with the columns would be entirely utilized for pipes, the pipe shaft would add very little to the size of the column.

Where the pipes are placed in shafts here and there, wherever provided, no structural provisions are necessary. Access doors are provided over the floor, not for regular access but for inspection to determine any troubles which may occur.

TAKING CARE OF BRANCHES.

The tendency nowadays is to conceal all branches. Exposed branches are more unsightly than exposed risers. There are four or five ways of doing this. Probably the best way is to carry the branches under the floor in the furred ceiling where no special furring is necessary for the purpose. They may also be carried in the floor fill. The objection to this is that with the best of protection possible, concrete fill is poured around the pipes, fixing them solidly in place and expansion snaps off the branch. This applies, of course, to steam risers. Plumbing riser branches may be placed in this position because there is not the expansion.

A fine method of arranging branches connected to radiators is to place them in horizontal chases back of the baseboard. Two course of brick can be left out of the curtain wall on the inside at the floor line, forming a chase for the branches from the concealed risers. Connections are made directly through the baseboard to the radiators. It means a very neat construction and it is very simple. If the wall is of interior tile construction, 12-in. tile for example, 8-in. tile may be used for the bottom course on each floor, and the 12-in. tile above, leaving a chase which is 4 in. thick and 4 or 5 in. high above the finished floor; this may be easily covered with the baseboard.

When we come to branches in the interior plumbing work, the difficulty is perhaps a little greater. If they are to be in the floor fill, a depth of about 8 1/2 in. is required. This is accomplished, as a rule, only by placing a thin concrete slab of short span in the space occupied by the bathroom and obtaining the 8 1/2-in. fill without carrying above the regular floors.

Another way for typical floors, where one bathroom is below the other in tiers for ten, fifteen or twenty stories, is to fur the bathroom ceiling. This requires a small amount of furring and probably is the best method.

When the branches are concreted in to the floor fill, as they often are, they are subject to breakage at any time. I have seen 4-in. closet branches, cemented in this way, snapped off at the risers and the fittings broken.

AIR INTAKES FOR VENTILATING SYSTEMS.

Finally there is the matter of providing intakes for air for a building that is to be ventilated. If the ventilating is not considered at the start, considerable trouble is experienced later. Usually a large part of the ventilation is for space below the ground floor. Air intakes and risers, then, must be provided at some points in this building to admit the air and carry it down, while risers of sufficient area must be provided to take it up again, because it has eventually to go through the roof. It sometimes involves a considerable area for the intake. The area may be quickly determined roughly as follows: if we consider that approximately the entire volume of the basement is to be ventilated, some of it, say, with a 3-min. air change, some 4-min. and some 10-min. or 20-min., we can figure roughly the average period of air change, say, six or eight minutes. Then dividing the contents by this figure gives the cubic feet per minute. Dividing the cubic feet per minute by 1000, the usual intake velocity, gives us the area in square feet of the opening required down through each floor. This opening may be in one location or there may be several openings. It is better, of course, to distribute the openings near the positions where ventilating is required, but if only one opening is used, the fans can usually be located so as to secure good distribution of the air.

Aerology for Amateurs and Others

(*Continued from Page 39*)

for the present, at least, be considered as of little importance. The still older belief that carbon dioxide is harmful must also be discarded. While it is possible to find extreme instances where the amount of carbon dioxide in the air is sufficient in amount to exert a harmful effect, still under ordinary conditions this is not the case. The work of Flügge and Leonard Hill has demonstrated quite conclusively that the important factors which influence, primarily, comfort, and secondarily, our physical well being, can be explained by faulty relations between temperature, humidity and air motion, and temperature and humidity can be reduced to one factor, namely the wet-bulb temperature. It is evident further that the wet-bulb temperature should be constant for a given air motion and this wet-bulb will increase as the air motion increases. These three factors then and their inter-relations can be considered as of the first importance in determining comfort and health, in so far as these physical condiions are concerned.

HIGH WET-BULB TEMPERATURE CAUSE OF CALCUTTA TRAGEDY.

We have in this factor, namely the wet-bulb temperature, probably the true explanation of the deaths of the English garrison in the "Black Hole" of Calcutta. Without tiring the reader with calculations as to air space and air change in this room it may be safely assumed that with the two windows open enough air was secured to maintain life and that the deaths recorded could not be due to air contamination or lack of oxygen. If we consider, however, the prevailing high temperatures in a tropical country during this season of the year, with possibly also a high outdoor humidity, and if we also consider the amount of heat given off by the occupants of this room, together with the moisture from their lungs and perspiring bodies, it is perfectly obvious that a high humidity and an unbearable temperature was the result. The statement of Mr. Holwell that the men were crying for water and also that the perspiration stood in large drops on their faces, is further evidence that the large number of deaths was due to heat prostration rather than to a deficient air supply, in other words that the *wet-bulb temperature* in this room reached a point where sufficient heat could not be given off and heat prostration was the inevitable result. *(To be continued.)*

The Heating and Ventilating Magazine

A MONTHLY JOURNAL OF ENGINEERING PROGRESS

Member of the Associated Business Papers Inc.
Member Audit Bureau of Circulations.

Vol. 20 January, 1923 No. 1

Published Monthly at Cooperstown, New York, by the
HEATING AND VENTILATING MAGAZINE COMPANY
Executive and Editorial Offices
1123 BROADWAY, NEW YORK
A. S. ARMAGNAC . . . . . President and Editor
GUSTAVE PETERSEN, Secretary-Treasurer and Business Manager

European Representative
W. G. HOLLINWORTH, 38 Victoria St., London, S. W.

Subscription	$2.00 per year
Canada	2.25 per year
Foreign Countries	2.50 per year
Back numbers	25 cents each

OUT of the conflicting ideas as to what does and what does not constitute good ventilation we are gradually reaching a common, yet advanced, ground upon which all can, at least, start forward together. This basis is the acceptance of a definite relation between temperature, humidity, air movement and certain other factors in providing a comfortable and healthful atmosphere. As the chief exponent of this method of approaching the problem, Dr. E. Vernon Hill, perhaps best known as the author of the Synthetic Air Chart, is undoubtedly in a position to speak with more than usual authority. In fact, his conception of the art of ventilation has been responsible for the coining of a new word—aerology—to embrace the factors which are not covered by the present term.

Our readers, therefore, will be interested to learn that Dr. Hill has prepared an exhaustive review of his studies on the subject which will appear in these columns during the coming months under the general title of "Aerology for Amateurs and Others; the Evolution of Modern Ventilation and Its Effect on Present and Future Practice." The first installment, which will be found in this issue, deals with the historical aspects of the subject and will serve as a preface to the important articles to come.

NOW that the American Society of Mechanical Engineers has adopted the code of ethics for engineers, which was compiled by five of the national engineering societies, a long step forward has been taken in establishing a proper status for the entire engineering world. It is a mistake, however, as some reports have had it, to say that the mechanical engineers' society is the first of the organizations interested to adopt the code. As a matter of fact, this honor belongs to the American Society of Heating and Ventilating Engineers, for favorable action on the code in its present form was taken by the society at its annual meeting in New York last January. As a concise summary of the main guiding principles for engineers, the code is beyond criticism. On some points which have been agitated more or less, such as the activities of engineers in connection with the solicitation of advertising for association organs, the code is conspicuously silent. The code as it stands, however, is a splendid achievement and will long serve as the Ten Commandments of engineering practice.

IN presenting a paper, in this issue, on constructive mechanism as applied to the centrifugal fan, we feel that we are giving many of our readers their first inside knowledge of how fan design is actually developed. This applies to architects as well as to heating engineers, for it is not at all uncommon to find men in both fields who are under the impression that a fan or blower is a piece of apparatus assembled in some manner, carefully tested as to capacity and horsepower requirements, but manufactured with little regard to the finer details of design. They do not begin to realize how much consideration is given by fan manufacturers to this extremely important point and that the stresses set up in the apparatus are all carefully established and the various members so chosen, with proper factors of safety, as best to meet the conditions.

Of course, the more prominent practising engineers are generally technicians, thirsty for knowledge of a technical nature regarding all heating and ventilating equipment. They will appreciate at once that there is being placed in their hands information whereby they may quickly check the proportions of the various working parts of any apparatus they are about to purchase and satisfy themselves that it conforms to the best and latest practice in fan design. But the fact is that most heating and ventilating engineers have secured the best part of their training through the stern school of experience and, as we all know, in that school little opportunity is offered to learn the theory of the art, especially in such a technical branch as fan engineering. We might go even further and say that many draftsmen and junior engineers are gaining most of their education along with practical experience in the drafting room. It has been brought out very forcefully within recent months that the educational facilities in this branch of engineering are still sharply limited, in spite of the splendid work being done in those institutions which have set apart courses on the subject. We dare say many a young man would welcome a chance to enter the fan engineering field but for his sense of incapacity through lack of knowledge of its fundamentals, and it is articles such as the one here presented that will give him the necessary equipment to keep pace with the leaders of his profession.

American Storms Which Figure in the Work of the Heating Engineer

Hurricanes, Cyclones and Tornadoes Compared with Asiatic Typhoons and Monsoons

BY G. J. O'CONNOR,

Observer, United States Weather Bureau.

FROM Biblical times men have striven to learn "Whence the winds cometh and whither they goeth." During the last three centuries the general circulation of the atmosphere has been studied and instruments devised for measuring and recording its varying phases. Dante's work completed the passage from the ancient mythological treatment of natural phenomena to the more rational recognition of one Creator whose handiwork pervades modern science. Galileo (1607) the thermometer; Toricelli (1642) the barometer; Newton (1673) optical research—these are household names.

In 1831 William C. Redfield, of New York, compiled a chart of the then noted hurricane of 1821, and left memoirs which established the rotary motion of hurricanes. Many individual authors have added valuable memoirs to literature on the subject of the weather, but it was not until times comparatively recent that the leading meteorologists of the United States Weather Bureau, under direction of the chief, Charles F. Marvin, published a work calculated to enlighten the public in general in the art of weather forecasting.

ORIGIN OF CYCLONES A MYSTERY.

This work, therefore, has to deal with atmospheric motion in "whirls." It is the practical application of meteorology, as a science, to the affairs of everyday life. And the authors admit at the outset that probably nobody yet knows just how typical cyclones begin. In many respects—in their origin, in their temperature distributions, and the laws of their movements—cyclones still remain the meteorological mysteries they have ever been.

Cyclones and anti-cyclones are as closely related and are as fully the complements of each other as are hills and hollows. When illustrated by contrast, as in Fig. 1, it may be seen that near the center of a cyclone there is an upward movement of the air, while in the anti-cyclone it is a central downward movement. This is the essential distinction. But the former has many characteristics requiring separate presentation.

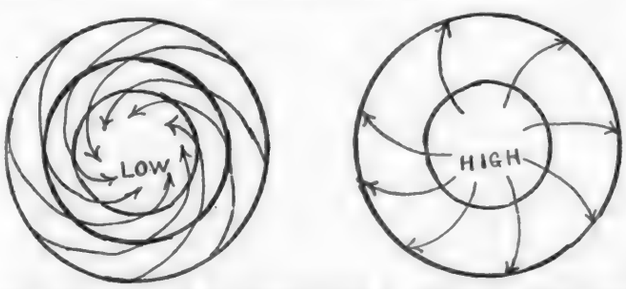


FIG. 1—DIRECTION OF WHIRL FOR A CYCLONE (LOW) AND AN ANTICYCLONE (NORTHERN HEMISPHERE).

There are two classes of cyclones, the tropical and the extra-tropical. Both are migratory. The tropical storm usually enters the Temperate Zone, but the extra-tropical never invades the Torrid Zone. The extra-tropical storms traverse the American continent in the middle latitudes. Many of these have their origin in the Indian Ocean, or in the semi-permanent area of low pressure over the Aleutian Islands. They approach the American continent usually north of California. Their attending clouds are heavily laden with moisture. This burden must be lightened before the storm can acquire sufficient energy to cross the Rocky Mountains; hence the heavy seasonal rains on the north Pacific Coast.

Having crossed the plateau region of the Rockies, the cyclone usually takes a southerly sweep over the plains States; thence northeastward over the lake region and down the St. Lawrence Valley. Sometimes the storm will travel across the Gulf States, and thence northward along the Atlantic coast; sometimes a secondary storm develops within the southwest quadrant of an area of low pressure, whose movement has become

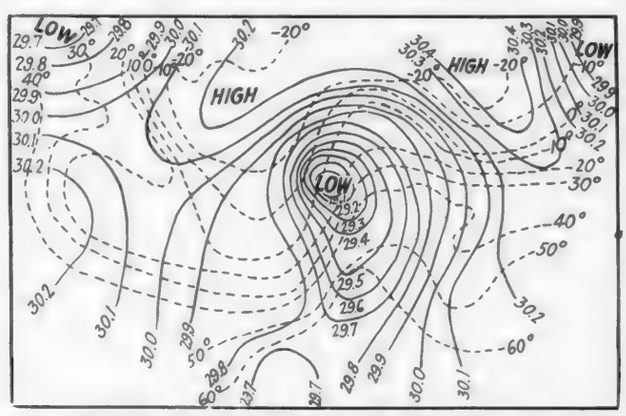


FIG. 2—INTENSE CYCLONE CENTERED OVER IOWA. TYPICAL MAP OF FAST-MOVING STORMS OF RECORD.

sluggish; the secondary usually follows the primary storm along the beaten tracts toward the New England coast.

HURRICANES AND TYPHOONS.

Tropical storms occur in the Torrid Zone over portions of all oceans, except possibly the south Atlantic. In the Western Hemisphere, they are most numerous over the West Indies and the Gulf of Mexico, where the annual frequency is about four. These occur during the months of August to November In the Eastern Hemisphere over the Sea of Bengal, about eight a year; and in the China Sea, about twenty-four a year. In these Asiatic regions the tropical cyclone is called a typhoon; in America it is the hurricane.

The hurricane has its inception in the region of the doldrums, a movable (northward and southward with the sun) belt of atmosphere near the equator where the atmosphere is warm and humid, and rains heavy and frequent. Vertical convection and the earth's rotation contribute to the hurricane's mechanism. The diameter at the center varies from five to thirty miles.

At the center of the hurricane rain ceases and the winds abate. Here is the "eye of the storm." Vortical movement has developed a funnel, so to speak, in the aerial ocean through which a clear sky may be seen. (Fig. No. 6).

The isobars surrounding this central area are symmetrical and nearly circular; the temperature distribution is equal on all

sides; rains are torrential and nearly evenly distributed all around. In the tropics the hurricane has a surface area from 200 to 500 miles in diameter. After pursuing a westerly course, sometimes to the Texas coast, it moves to higher latitudes where it assumes, more or less completely, the characteristics of the extra-tropical storm. It has no traveling companion—the anti-cyclone. But an anti-cyclone usually develops to the westward of it, as the hurricane advances northward along the coast.

CHARACTERISTICS OF TRANSCONTINENTAL STORMS.

Transcontinental storms have many properties similar to those of the tropical cyclone, such as low pressure, abundant precipitation, instantaneous wind directions, etc., but their temperature distribution is vastly different. In size these extra-tropicals vary from a circular-shaped area 1000 to 1500 miles in diameter, over the plains States, to a V-shaped area which may include the entire country east of the Rockies with its center near the Great Lakes. These "whirls" have an eastward motion of translation of about thirty miles an hour; usually a little slower in summer, but in the colder months this rate of movement is maintained with considerable regularity. Scarcely a winter passes, however, without the entire country experiencing the passage of at least one cyclone at

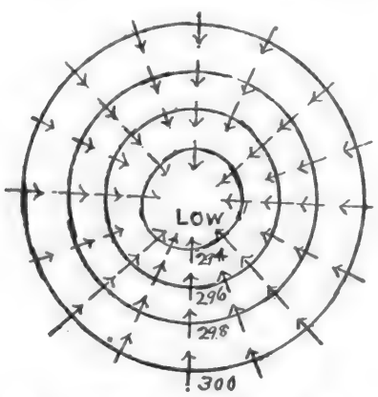


FIG. 3—FIRST STAGE OF AIR IN MOTION.

The inflow starts perpendicular to isobars (lines of equal barometric pressure) and might so continue on a non-rotating earth.

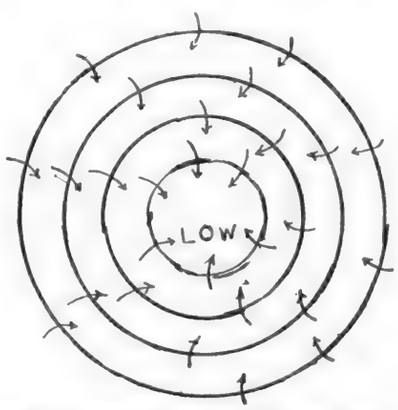


FIG. 4—SECOND STAGE, EARTH ROTATING.

Air Currents Crossing the Isobars to Right of Perpendicular.

much faster rate, covering the distance from Vancouver to New Foundland in seventy-two hours.

A moderate rise in temperature precedes its approach from the west, and a "cold wave," usually intense, follows it. (Fig.2.)

These changes in temperature, more or less severe at times, are peculiar to the air circulation about an extra-tropical cyclone. The flow of the surrounding air toward the center of the low pressure area necessarily starts along lines that cross the isobars at right angles. (Fig. 3.) "If the earth were at rest," say the authors, "other thing remaining the same, the surrounding air masses would move directly in toward the center from all sides and either fill up the 'low,' or, if portions of the air within were being carried upward by convection, then the inflow might, or might not, just sustain the inflow by convection."

But with the earth in rotation the circumstances are changed. In latitude about 30°, North, the barometer is normally high. A portion of air here moving at the rate of one mile per hour toward the center of low pressure will be turned to the right of its onward course in the Northern Hemisphere. The deflective influence of the earth's rotation acts with pronounced effect upon bodies moving freely at low velocities. (Fig. 4.)

STARTING OF THE "WHIRL."

Since the air, by reason of these contending inward and deflective forces, readily flows into the center of an incipient "low," the causes that produce the cyclone, now intensify the pressure gradient, causing a deeper depression. The inflow of air toward the center becomes more rapid and the winds are deflected more strongly to the left. (Fig. 5.) This left-hand deflection is produced by a component of the pressure gradient, which at this stage of development, is now greater than the earth's deflective force. The "whirl" is now started. The deflective force becomes passive. Centripital force here aids in causing the path to curve to the left. The incipient inflow of air has developed a cyclone and the gyration has now become counter-clockwise. (Fig. 1.)

DIRECTION OF STORM NOT DEPENDENT ON DIRECTION OF WIND.

As the cyclone moves eastward, with its air currents directed inward across the isobars, it is obvious that ordinarily the chief air convergence, due in part to increase in latitude, must be on the front or east side. Easterly to southerly winds bring on warm moist air from the Atlantic and the Gulf, cloudy weather and more or less rain. (Fig. 2.) But, because rain is thus falling on an easterly wind, it does not follow that the storm is coming from the east. The storm center has yet to cross the meridian where these conditions are observed. A storm center usually advances in a direction contrary to that from which the wind is blowing, because the winds gyrate around the center in a manner reverse to the movement of the hands of a clock.

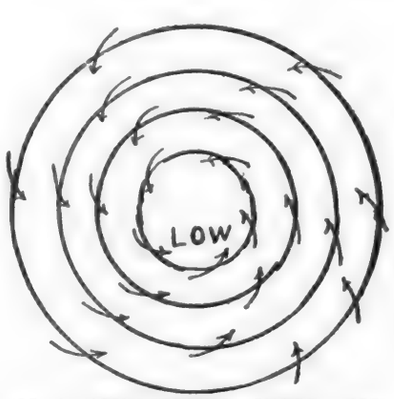


FIG. 5—EQUILIBRIUM STAGE FOR NEARLY FRICTIONLESS FLOW.

In the free air the friction and resistances are at a minimum, and the flow is there nearly parallel to the isobars.

And as the wind veers from south to southwest, the storm center having crossed the meridian of observation, a break in the clouds becomes apparent; the stronger westerly winds force the clouds more rapidly eastward; a gradual increase in barometric pressure is noted with a falling temperature; presently the winds shift to the northwest; the anti-cyclone becomes the dominant factor in weather control, and, with its downward pressure and northwest gales, clears the sky and cools the air.

Owing to the downward circulation of air from the center, the anti-cyclone lacks the dynamic complexities that lend interest to the cyclone. It is the fair weather element that produces an exhilarating change of atmosphere after the passage of a storm. (Fig. 1.)

THE ASIATIC MONSOON.

Those living near the seashore appreciate the diurnal changes in temperature due to land and sea breezes; sometimes only moderate; again very heating and cooling. This same principle is conducted on a larger scale, sometimes on a gigantic scale, in the development of the Asiatic monsoon, a term applied to seasonal winds which change in direction on account of the migrations, north and south, of wind belts in the planetary circulation. In Spring the surface of the land warms more quickly and becomes hotter than the sea; and in Fall the reverse is the case. Barometric pressure tends to be higher over the colder region than over the warmer. Accordingly there is a tendency for air to flow in the lower levels of the atmosphere from the colder toward the warmer region.

Within a belt extending from 10° to 15° on either side of the Equator, seasonal changes of temperature are sufficient in range to permit of the occurrence of temperature differences adequate to the development of the true monsoon. The monsoon of the hot season is generally of greater strength than that of the cold season, because, being usually a sea wind, the air is fully charged with moisture. Tidal waves sometimes occur; and torrential rains begin as ascentional movement takes place at varying elevations on land.

EFFECT OF POSITION, OUTLINE AND RELIEF OF ASIA.

The position, outline and relief of Eastern and Southern Asia favor the development of monsoons to a much greater extent than any other part of the world. So, too, the tornado is peculiar to geographical circumstances within the United States. The warm currents of air from the Indian Ocean sweeping inland and upland against the Himalayas precipitate torrential rains. The combination of meteorological conditions essential to the genesis of the tornado is not found elsewhere like in the United States.

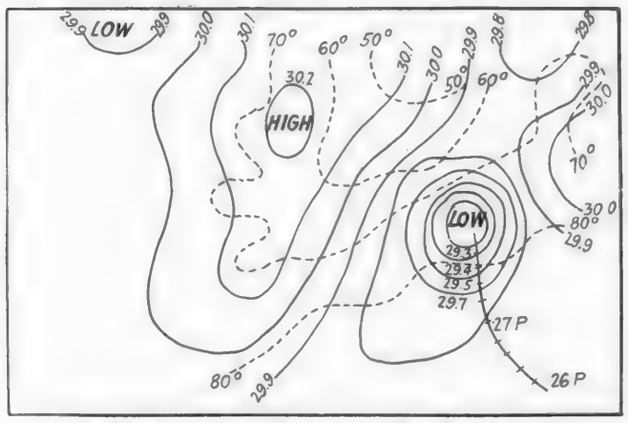


FIG. 6—NOTABLE HURRICANE OF RECORD.
This hurricane approached the continent from the Bahamas, August 26, 1893, its center passing over the Carolinas, on the 27th; Western Virginia, on the 28th, and near Quebec on the 29th.

TORNADO PECULIAR TO AMERICA.

That tornadoes should often occur east of the Rocky Mountains is obvious from the position and trend of these mountains themselves and the location of the Gulf of Mexico. No other similar combination of mountain and ocean wind controls exists; and therefore no other place has in all respects the same kinds, frequencies and intensities of storms.

In no other respect, however, is there any analogy between the monsoon and the tornado. The typhoon may resemble the hurricane, but the tornado is the product of atmospheric conditions peculiar to America only.

The tornado is an off-shoot of the cyclone; a miniature though very violent cyclone within a cyclone. Its whirling air movement is likewise counter-clockwise. It commonly occurs in the south-eastern quadrant of an area of low pressure around which temperature gradients are very pronounced and the relative humidity is moderately high.

A number of tornadoes may develop, even close together, in connection with a single cyclone. They occur after the maximum temperature for the day has been attained, usually between 3 P. M. and sunset, and are most frequent in April, May and June. The diameter of a tornado is rarely more than 1000 ft.; the length of its path may be only 100 yards; or it may be 300 miles; its winds are the swiftest known.

The wind velocities of the hurricane are the strongest on the Beaufort scale, but no instrument for measuring either velocity or force has yet withstood the passage of a real tornado. From the nature of the destruction wrought by it, the wind velocity is estimated at from 100 to 500 miles an hour. It is, therefore, by far the smallest, briefest, and severest of all storms.

Commission Cutting is Wrong

Let's Stop It

COMMISSION cutting is a disease resulting from an attitude of mind. The engineer who cuts commissions is like the guest at a banquet where enough is provided for all. His fear that he won't get his share makes him start to grab, instead of waiting to be served. In the riot that follows, what was an ample sufficiency is wasted to a woeful lack. And every one suffers because of the lack of control in the man who started the riot.

The disease of commission cutting endangers the whole fabric of our civilization.

Business depends on three fundamentals: knowledge, confidence, interest.

Knowledge needs no comment. Interest is what makes genius; the infinite capacity for taking pains; the ceaseless striving towards perfection. It, too, needs little comment.

The greatest fundamental of all is confidence. And how great a part confidence plays in the business of life! Everything human beings do is based on confidence. It begins at the cradle and endures as long as life lasts.

Engineering is the application of formulas to solve problems of construction. And all formulas are based on confidence. The average engineer very often knows as little of the principles of the formulas he uses in his daily work, as the fireman who stokes a boiler knows of the principle of heat. His use of formulas is based on confidence.

Reflection on the part that confidence plays in all human relations, will show any man who thinks, what destruction is started when commission cutting begins to undermine confidence.

The disease of commission cutting can be instantly stamped out. It requires no code of ethics, no laws, no supervisory commissions. Humanity can't be made moral by statute. It requires only that each and every engineer appoint himself a committee of one to govern his own conduct.

And the result will so stiffen the engineer's will to do, that no inducement could make him cut a commission.

The human will was given to men to check evil tendencies as a granite coast checks the ocean. It is weakened by every compromise where a principle is sacrificed.

Engineers know well—the destruction caused when the natural forces they handle break from control. And as engineers they should, more than any other class, study the greatest force men have to deal with—human nature. It has its guiding principles which cannot be violated without enormous destruction.

Commission cutting is a two-edged sword that works equal destruction within and without. It wrecks the peace of mind of the individual and tears down the fabric of confidence on which all human relations are based.

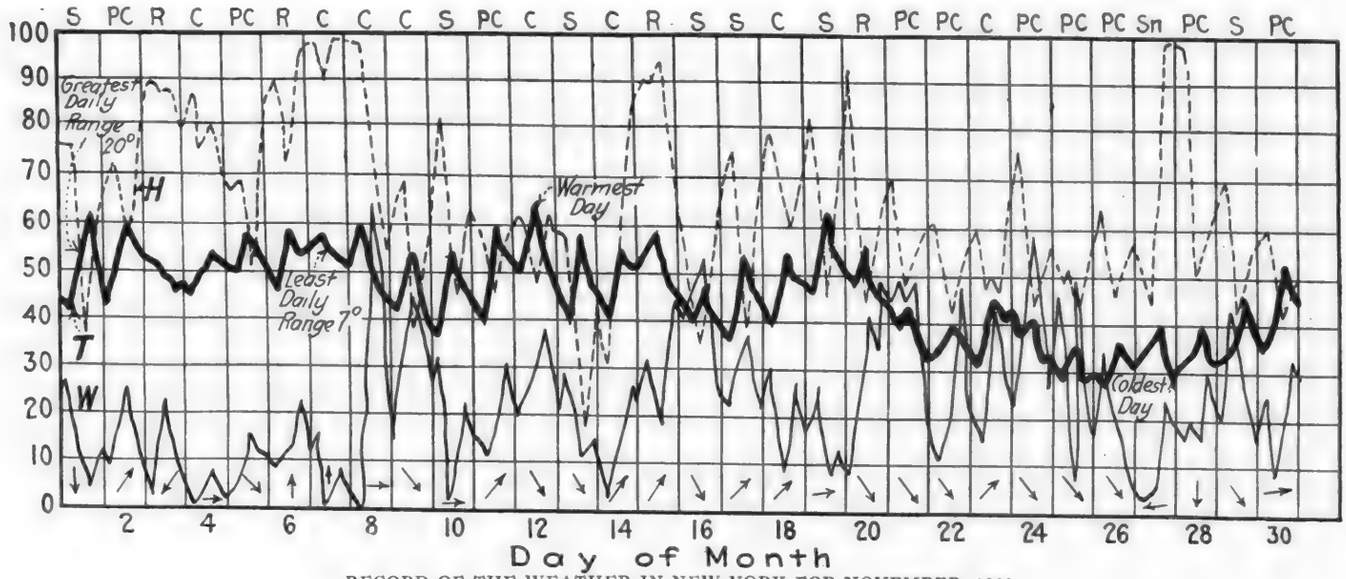
Let's stop it now!

Appoint that committee of one immediately. And keep him on the job as long as you live.

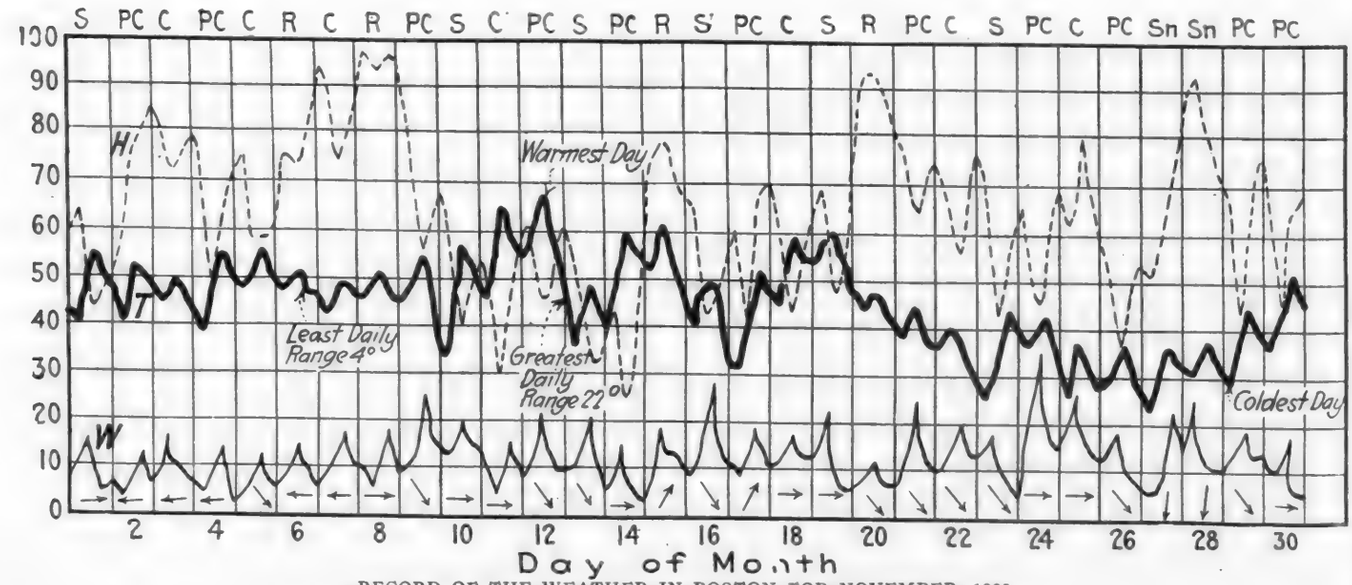
The penalty the commission cutter pays in all that he is and does is enormously greater than the utmost realization of the fears that make him cut commissions.

The Weather for November, 1922

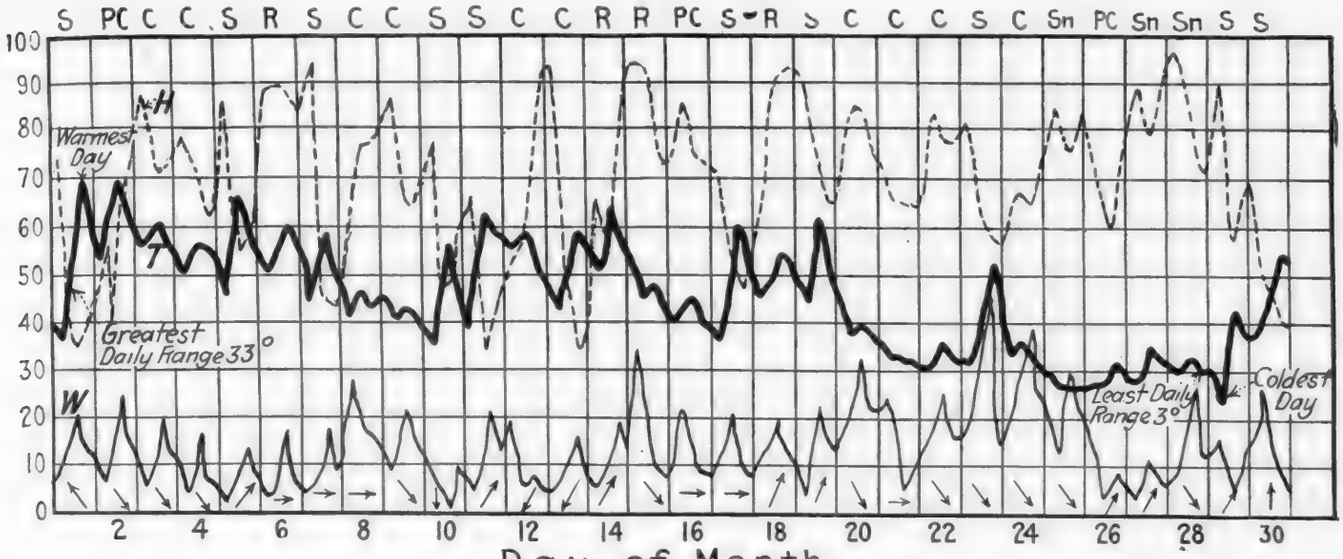
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	65	66	69	66	73
Date of highest temperature	12	12	1	5	5
Lowest temperature, degrees F.	27	24	23	21	25
Date of lowest temperature	26	27	29	25	25
Greatest daily range, degrees F.	20	22	33	19	24
Date of greatest daily range	1	12	1	30	29
Least daily range, degrees F.	7	4	3	4	6
Date of least daily range	7	6	28	20	8
Mean temperature for month, degrees F.	45.4	43.8	45.3	44.6	48.8
Normal mean temp. for month, degrees, F.	44	41	43.2	41.2	45.1
Total rainfall, inches	1.16	0.84	1.31	2.66	2.36
Total snowfall, inches	1.0	0.9	1.0	0.2	Trace
Normal precipitation, this month, inches	3.44	4.1	2.55	2.5	2.88
Total wind movement, miles	13209	7511	8730	9709	9784
Average hourly wind velocity, miles	18.3	10.4	12.1	13.5	13.5
Prevailing direction of wind	N. W.	W.	S. W.	W.	S.
Number of clear days	7	7	5	5	11
Number of partly cloudy days	11	11	3	5	10
Number of cloudy days	12	12	22	20	9
Number of days on which rain fell	5	6	5	10	10
Number of days with snow	1	2	3	2	0
Snow on ground at end of month, inches	0	0	0	0	0


S PC R C PC R C C C S PC C S C R S S C S R PC PC C PC PC PC Sn PC S PC
Greatest Daily Range 20°
H
T
W
Warmest Day
Least Daily Range 7°
Coldest Day
Day of Month

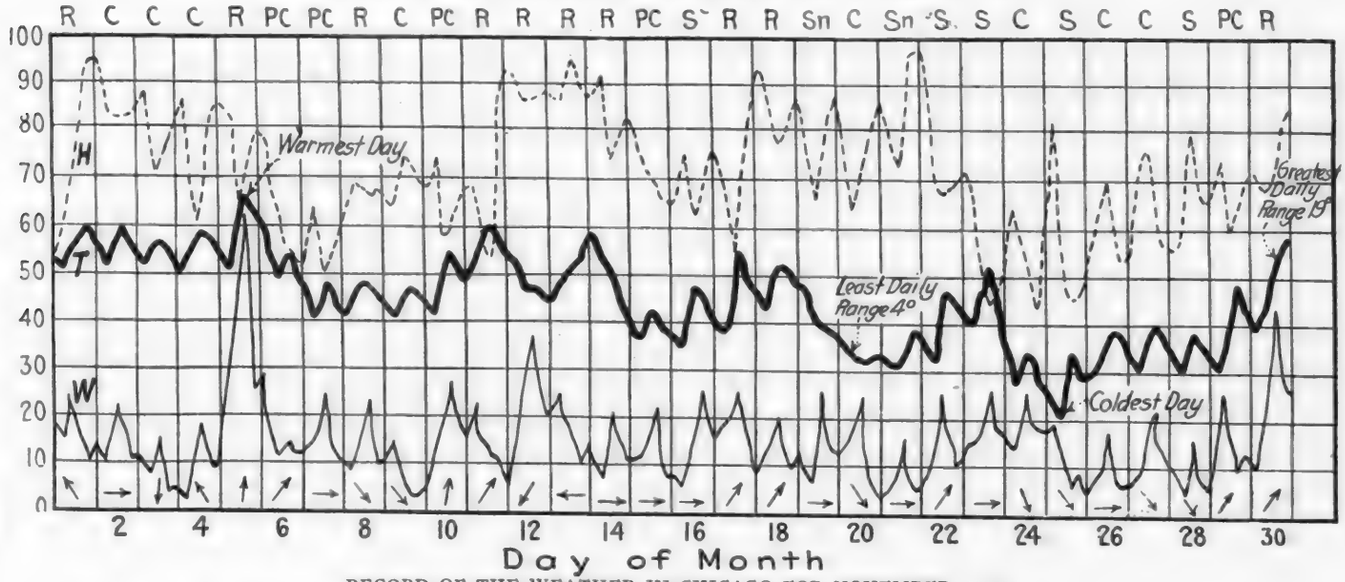
RECORD OF THE WEATHER IN NEW YORK FOR NOVEMBER, 1922.
(Hourly Observations of the Relative Humidity Plotted on this Chart).


S PC C PC C R C R PC S C PC S PC R S PC C S R PC C S PC C PC Sn Sn PC PC
H
T
W
Warmest Day
Least Daily Range 4°
Greatest Daily Range 22°
Coldest Day
Day of Month

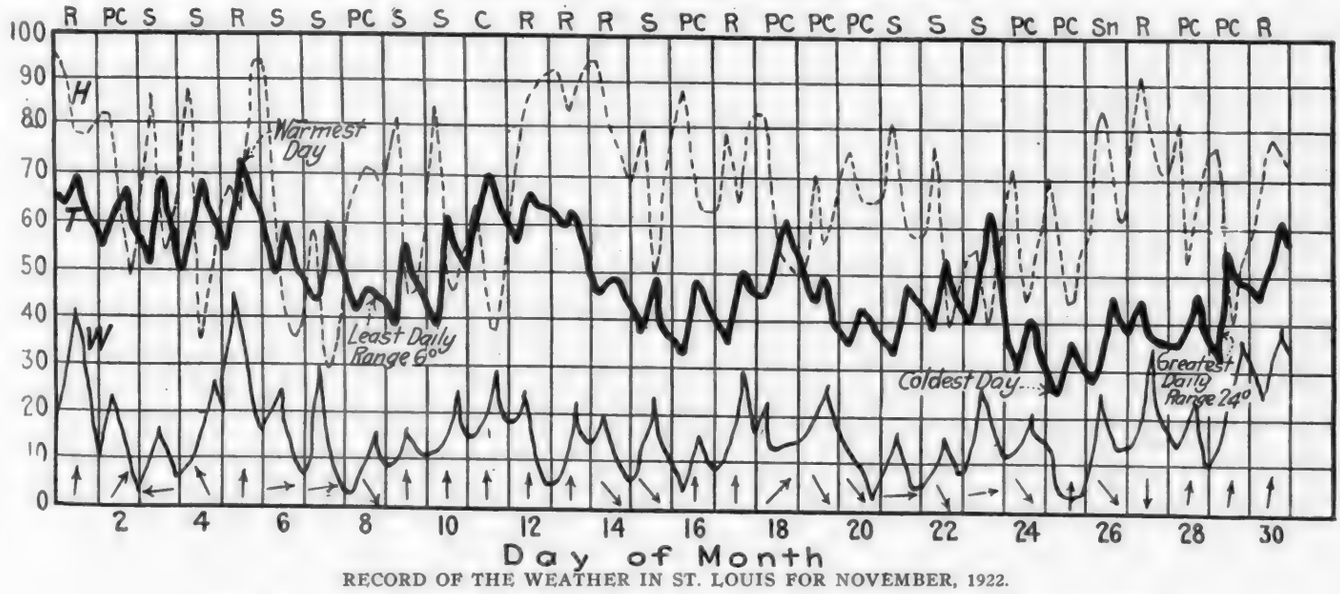
RECORD OF THE WEATHER IN BOSTON FOR NOVEMBER, 1922.


S PC C C S R S C C S S C C R R PC S R S C C C S C Sn PC Sn Sn S S
Warmest Day
H
T
W
Greatest Daily Range 33°
Least Daily Range 3°
Coldest Day
Day of Month

RECORD OF THE WEATHER IN PITTSBURGH FOR NOVEMBER, 1922.



RECORD OF THE WEATHER IN CHICAGO FOR NOVEMBER, 1922.


R PC S S R S S PC S S C R R R S PC R PC PC PC S S S PC PC Sn R PC PC R
Warmest Day
H
T
W
Least Daily Range 6°
Coldest Day
Greatest Daily Range 24°
Day of Month

RECORD OF THE WEATHER IN ST. LOUIS FOR NOVEMBER, 1922.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings taken at 8 A. M., 12 M., and 8 P. M.
S—Clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing directions of wind.

New Oil-Burning Regulations for Domestic Equipment

Regulations of the National Board of Fire Underwriters for the construction and installation of oil-burning equipments, and for the storage and use of fuel-oils used in connection therewith, as recommended by the National Fire Protection Association, have been published in a new edition. These regulations are in two parts. Those referring to plants where an attendant is on hand constantly are identical with the fuel-oil regulations edition of 1920. The regulations for the construction and use of oil-burning equipments for domestic use are new and are given herewith in full:

NOTE.—These regulations do not apply to oil burning devices employing a wick.

PREFACE.

It is recognized that the safest and therefore most desirable type of oil-burning system for domestic use is that employing a pump to deliver the oil to the burner, and having all piping and the tops of all tanks located below the level of the burner base.

Systems employing a gravity or pressure feed to the burner introduce a greater hazard and should not be permitted unless installed in full compliance with the following regulations.

REGULATIONS.

Oil used for fuel under these rules shall be a topped or distilled oil having a flash point of not less than 100° F., closed cup.

In determining the flash point, either the Elliot, Abel, Abel-Pensky or Tag Closed Testers, shall be used, but the Tag Closed Tester (standardized by the United States Bureau of Standards) shall be authoritative in case of dispute. In such cases the tests shall be made in accordance with the methods of tests as adopted by the American Society for Testing Materials.

An oil-burning system shall consist of all equipment connected to the burner and located within the building, including auxiliary supply tank and provisions for filling same, piping, burner, and all accessories.

Only systems approved by the Inspection Department having jurisdiction shall be used.

Where these systems are used, their hazards shall be recognized and the following rules and precautions rigidly observed:

1. Capacity and Location of Storage Tanks.—Storage tanks shall preferably be located outside underground, as provided in Section 2, paragraph 17 of the preceding regulations. When located inside of a building and above ground the aggregate capacity of such storage tanks shall not exceed 275 gal.

2. Material and Construction of Tanks.—The material and construction of outside tanks shall be in acccordance with the requirements of Section 1, paragraphs 1 to 8 inclusive of the preceding regulations. Inside storage and auxiliary supply tanks of more than 10 gal. capacity shall be constructed of galvanized steel, basic open hearth steel, or wrought-iron of not less than No. 16 U. S. Gauge.

Auxiliary supply tanks of 10 gal. or less capacity may be constructed of brass, copper or galvanized plate of not less than No. 18 U. S. Gauge. Joints shall be made as specified for outside underground tanks in the preceding regulations.

3. Gravity and Pressure Tanks.—(a) Auxiliary supply tanks may be of the gravity or pressure type if suitable automatic safeguards to prevent abnormal discharge of oil at the burner are provided. No such tank shall have a capacity sufficient for more than one day's supply and in no case shall exceed 60 gal.

(b) If located within a building, gravity tank shall not be within 5 ft., or pressure tank within 10 ft., measured horizontally from any fire or flame.

(c) Gravity or pressure tank shall be substantially and rigidly installed on incombustible supports in such a manner as to insure protection against mechanical injury.

(d) Tanks for systems under pressure shall be designed for six times the maximum working pressure and be tested and proven tight at twice the maximum working pressure; maximum working pressure shall not exceed 50 lbs. Tanks shall be provided with a reliable pressure gauge and an automatic relief valve piped to discharge outside of the building.

(e) Gauging devices or test wells, the breakage of which would permit the escape of oil or vapor within the building shall be prohibited.

4. Filling in Auxiliary Tanks.—(a) Auxiliary tanks shall be filled by pumping from storage tank or if gravity or pressure tank contains the entire storage, fill pipe shall extend to and terminate outside the building, as provided in Section No. 1, paragraph 5 of preceding regulations, and in such cases tank shall be so installed that in case of overflow, oil will not enter building.

(b) Tank shall be provided with an overflow connection draining to storage tank. Overflow pipe shall be not less than one size larger than supply pipe from pump.

(c) The overflow pipe or gravity tank shall not be provided with valves or other obstructions; but overflow pipe of pressure tank and oil supply pipe shall be provided with inter-connected valves, so designed that the opening or closing of overflow pipe shall result similarly in oil supply pipe.

5. Pump.—Oil pump used in filling auxiliary tank from the main storage tank shall be of approved type, secure against leaks, with check valves located as close to pump as convenient. Pumps shall be rigidly fastened in place.

6. Piping.—(a) Standard, full weight, wrought-iron, steel or brass pipe with substantial fittings shall be used and shall be carefully protected against mechanical injury in a manner satisfactory to the inspection department having jurisdiction. In all piping systems proper allowance shall be made for expansion and contraction, jarring and vibration. All joints shall be made with litharge.

All piping shall be separated from electric wires not enclosed in approved conduit, raceways and armored cable, by some continuous and firmly fixed non-conductor creating a permanent separation, as provided in the National Electrical Code.

The use of tubing of any kind is prohibited.

(b) Supply pipe shall be not less than ¼-in. in diameter iron pipe size, and when oil is pumped to the burner, return pipes shall be at least the same size.

(c) Pipe connections to tanks shall be suitably reinforced, and proper allowance made for expansion and contraction, jarring and vibration.

(d) Openings for pipes through masonry walls below the ground level shall be made oil-tight and securely packed with flexible material.

(e) All connections shall be made perfectly tight with well-fitted joints. Unions shall be used at burners to facilitate removal. All unions shall be of approved type, having conically faced joint, obviating the use of packing or gaskets.

(f) Piping shall be run as directly as possible, and in the case of pumping systems, so laid that if practicable the pipes are pitched back toward the storage tank without traps.

(g) Systems under pressure shall be designed for six times the working pressure, and installation when complete shall be tested and proven tight at twice the maximum working pressure.

7. Valves.—(a) Readily accessible valves shall be provided near each burner and also close to the auxiliary tank in the pipe line to burners.

(b) Control valves shall be of approved type provided with stuffing box of liberal size, containing a removable cupped gland designed to compress the packing against the valve stem and arranged so as to facilitate removal. Valve shall be designed to close against the supply, and to prevent withdrawal of stem by continued operation of the handwheel. The use of packing affected by the oil or heat is prohibited.

8. Burners.—(a) The size of the orifice through which the oil is supplied to the burner shall be limited to furnish only sufficient oil for maximum burning conditions when the controlling valves are wide open.

(b) Valves shall be arranged so as not to enlarge the orifice.

(c) Burners containing chambers which allow the dangerous accumulation of gases, or oil conveying pipes or parts subject to intense heat or stoppage due to carbonization are prohibited.

(d) Burners shall be so designed as to permit of ready cleaning and not allow the leakage of oil.

9. Pilot Light.—Automatic systems shall be so designed that the flame cannot be extinguished by operation of the automatic control valve, or a gas pilot light

shall be provided in the combustion chamber.

10. Furnaces or Ranges.—(a) Previous to the installation of the burner, the ash door of the furnace shall be permanently removed, or bottom ventilation otherwise provided to prevent the accumulation of vapors within the ash pit.

(b) Stoves or ranges originally designed for use of fuel other than oil should not be used in connection with oil burners unless spaces in which vapors might collect are adequately vented.

(c) No damper shall be permitted in the chimney uptake that may entirely shut off the passage of fumes or gases up the flue.

(d) No combustible material shall be stored within 10 feet of furnace door.

11. Fire Protection.—(a) Any woodwork, wooden lath and plaster partition or other combustible material within 4 ft. of the sides or back or 8 ft. from the front of the furnace shall be covered with approved plaster board or other approved incombustible material. Above the furnace there shall be constructed a ceiling consisting of plaster board covered with sheet metal, or cement plaster on metal lath; said ceiling shall extend 4 ft. beyond the sides and back and 8 ft. from the front.

At least a 36-in. clearance is necessary between top and sides of breeching and flues from ceilings, partitions and other combustible material, unless the breeching and flues are insulated with two to four inches of asbestic magnesia lagging or equivalent, in which case the clearance may be reduced to 18 in.

(b) Near the furnace, and so located as to be convenient for use in emergency, there shall be provided a hand fire extinguisher of approved type suitable for use on oil fires.

12. Instruction Card.—A card giving complete instructions in regard to the care and operation of the system shall be permanently posted near the apparatus. Said card shall be placed under glass and framed.

13. Installation.—Oil burning equipment shall be installed only by properly qualified mechanics experienced in this kind of work. It is recommended that systems be installed by the manufacturer.

Fire Hazards of Emergency Heating

Timely suggestions which may well be passed on to the users of heating apparatus, are contained in a manual just issued by the National Fire Protection Association, on the subject of fire hazards of emergency heating. As the manual states, emergency heating arrangements, necessitated by the coal shortage, are likely to involve new fire hazards. In most cases the precautions necessary for safety are simple. The fundamental reason why emergency heating arrangements increase the danger of fire is that those using them are unfamiliar with the characteristics of substitute fuels and new devices and, unless warned, may not handle them properly.

Among the suggestions made for burning the various fuels are:

SOFT COAL

Bituminous or soft coal burns more rapidly and makes a hotter fire than anthracite. Furnaces designed for anthracite may not be suitable for burning bituminous coal.

As the furnace is likely to be hotter at times when bituminous coal is burned, especial precautions should be taken to keep furnace and smoke-pipe at a safe distance from woodwork and other combusible material, or to provide metal and asbestos insulation. Furnaces and pipes near cellar ceilings, even though they may have given no trouble during years of burning anthracite, will usually require metal shields and asbestos insulation if soft coal is to be used.

Bituminous coal requires more draft to insure good combustion than does anthracite, and a furnace designed for the burning of anthacite is pretty certain to cause unnecessary wastage in the form of soot when bituminous coal is burned in it. As accumulations of soot cause chimney fires it is of utmost importance to have the chimney cleaned early in the Fall and again during the Winter.

The production of soot can be minimized and the fire made to burn more satisfactorily if comparatively small charges of coal are put on at frequent intervals, and spread upon a portion of the fire bed only. The object of not covering the whole fire bed with coal is to permit the gases from the freshly-fired coal to be quickly ignited. As soon as fresh coal has been "coked" it should be spread out over the entire bed when it will burn as a bright fire without further smoke.

Bituminous coal, especially in large quantities, is liable to spontaneous ignition, and on this account should never be piled against or near the furnace, where heat might accelerate such ignition. There is comparatively little danger of spontaneous ignition if the coal is not stored in large quanities, and not piled deep in bins.

WOOD.

If wood is used in the furnace instead of coal, the same precautions should be taken as for soft coal, for wood, like soft coal, increases the amount of soot.

Fireplaces and their chimney flues should be carefully examined and thoroughly cleaned before a fire is started. Fireplaces which may have given no trouble during years of occasional use are not necessarily safe for a continuous hot fire. It is important that the fire place be provided with a substantial spark screen.

Burning waste paper or rubbish in an open fireplace is apt to be dangerous. If it is necessary to do this, put on only a small quantity at one time and watch the fire carefully.

GAS.

Gas stoves or other heaters burning natural gas should have ventilating flues to carry off the burned gas fumes, which are poisonous. Similar flues are desirable for heaters burning ordinary artificial gas. This is especially important where the heater is to be used continuously. In any case a gas heater should never be used in a room unless there is some ventilation, either a flue, or a door or window open. Do not use flexible gas tubing if the heater can be rigidly and securely connected to the gas pipe. If the use of flexible tubing cannot be avoided buy new, strong, metal-covered tubing and use as short a length as possible.

Always turn off the gas at the pipe rather than at the heater, if there are valves in both places. This is to avoid leaving gas pressure in the tube.

Gas heaters having open flames or hot parts with which clothing may come in contact should be screened. See that the heater is properly insulated from surrounding combustible material.

OIL-BURNING EQUIPMENTS.

If an oil-burning system is to be installed see that the installation and type of burner has the approval of the local authorities.

The safest type of oil-burning system for domestic use is that employing a pump to deliver the oil to the burner and having all piping and the top of all tanks located below the level of the burner base. Systems employing gravity or pressure-feed to the burner introduce a greater hazard and should not be installed unless the recommendations of the National Fire Protection Association for the Construction and Installation of Oil-Burning Equipments for Domestic Use are fully complied with.

ELECTRIC HEATERS.

In addition to ordinary care in placing electric heaters where there will be no danger of igniting combustible material, the only point to consider is the wiring. This is important. Electric heaters require large currents which ordinary house lighting wiring is not designed to carry. Overloading of electric wiring is dangerous. One electric heater, if of not over 660 watts rating may safely be used on the ordinary house lighting circuit if nothing else is connected on the same circuit at the same time. If the heater is over 660 watts rating, or it is desired to use electric toasters, irons or other appliances at the same time as the heater, have the electrician install a separate heater circuit.

To Holders of 1918 War-Savings Stamps.

An announcement issued by the United States Government Savings Systems reads:

"Uncle Sam invites you to exchange your 1918 War Savings stamps for his popular new savings security, Treasury Savings Certificates. Save your money and let it grow. Your postmaster or bank will give you full particulars."

Correspondence

The Analogy Between Water and Air Flow in Conduits.

EDITOR HEATING AND VENTILATING MAGAZINE:

Permit me to direct attention to a phase of ventilation discussion that all engineers know but almost universally ignore. All engineers insist on discussing the subject from viewpoints of mathematics, mechanics and cost. The primary consideration in ventilation must be from the viewpoints of sanitation and health. All other items are secondary.

It is this difference in viewpoint that makes most of the difference between engineers and physicians on the great subject of ventilation. Engineers know that pure water can be put through conduits of almost any character and extent, but in assuming that they can do the same thing with pure air they sometimes fail to consider the most fundamental differences between water supply practice and air delivery practice in ventilation.

In water supply the surfaces of the conduits are kept permanently submerged in the fluid handled. When service is intermittent, with periods of exposure of surfaces to air contact between periods of water flow, the discoloration of the water from oxidation products illustrates visibly that something has occurred within the conduits during the idle period.

The attention public health authorities now give to the sterilization at frequent intervals of all drinking water containers used by common carriers will be enforced on our air conduits in ventilation whenever our knowledge of what occurs in these conduits equals what we know about the necessity for absolute cleanliness in water supply.

New York. V. L.

The Gas House-Heating Experiment in Denver.

EDITOR HEATING AND VENTILATING MAGAZINE:

I note that your November issue mentions the American Gas Association convention in Atlantic City. But I think your informant overlooked something very vital to heating engineers that occurred there. It was the announcement of the plans of the Henry L. Doherty Company organization to make Denver, Colo., the first all-gas city in the world. The Doherty engineers have developed a process at Toledo, Ohio, by which all the coal carbonized is gasified, except the ash. A million dollars will be spent next year to equip the Denver plant with this process. It will make it possible for the local gas company, the Denver Gas & Electric Company, to sell 420 B. T. U. gas for a readiness-to-serve charge of $35.00 per year, and 40 cents per 1000 cu. ft. of gas.

This winter the Denver Gas & Electric Company has selected 100 buildings of various classes in which gas fuel will be substituted for coal. The data acquired from the study of these buildings will be used as the basis for a wholesale effort to substitute gas for coal fuel in Denver, after this year of study. The distribution problem has been studied in Denver and other places represented by Doherty properties for the past ten years and it is felt that the peak load phase of the distribution problem has been solved.

R. M. J.

Peoria, Ill.

How One Newspaper Interpreted the Report of the New York State Commission on Ventilation.

In an article appearing in the *New York Globe* for December 2, 1922, a writer, Tristam Walker Metcalfe, comes out with a broadside, reproduced in the accompaying illustration, in which he goes on to state that "ventilation of schoolrooms by the age-old method of opening the windows has been found in the schools of this city to give as good results as the forced air system upon which hundreds of thousands of dollars have been and are being spent by the Board of Education."

"The main difference in favor of the fan-ventilated room," he naively adds, "are warmer air, more uniform temperature and greater air movement.".

It is hard to see how such a statement can be justified and yet we dare say the average reader could easily draw the same conclusions when he reads the statement, as printed in the report, which runs:

Either window ventilation or plenum fan ventilation—if the plant be properly designed and operated—yields generally satisfactory results from the standpoint of the air conditions in the average schoolroom. We have found it possible to maintain by either of these procedures air conditions in the schoolroom that would be considered satisfactory by all the ordinary physical tests and conditions which are reasonably comfortable and satisfactory to the occupants. The main difference lies in the fact that the air of the fan-ventilated room is likely to be about 2° F. higher, and more uniform in temperature, and that the air movement in this method is considerably greater.

"We find that on the whole, other things being equal, the window-ventilated room at 67° F. is somewhat more comfortable than the fan-ventilated room at 69° F.

"It appears that 68° F. is a critical temperature as regards both comfort and susceptibility to respiratory disease, and the great advantage of window ventilation lies in the fact that the reduced air flow in the zone of occupancy permits this low temperature to be maintained."

Annual Meeting of American Society of Mechanical Engineers.

About 1200 members and guests, as compared with 1854 last year, attended the annual meeting of the American Society of Mechanical Engineers, in New York, December 4-7. Notable features of the meeting were the address on "National Leadership," by President Kimball and the report of Secretary Calvin Rice on his trip to the International Engineering Congress at Rio Janeiro, Brazil.

EMBER 2, 1922.

Can Ventilate Schools Adequately by Windows

Only Difference in Closed-Window Fan-Fed Rooms Is More Warmth and More Uniform Temperature, Tests Show.

By TRISTRAM WALKER METCALFE

Ventilation of schoolrooms by the age-old method of opening the windows has been found in the schools of this city to give as good results as the forced air system upon which hundreds of thousands of dollars has been and is being spent by the Board of Education. The main differences in favor of the fan ventilated rooms are: warmer air, more uniform temperature, and greater air movement.

59TH STREET LEASE INVOLVES MILLIONS

At an annual net rental of $50,000, the National Drug Stores Corporation has

The New York State Commission on Ventilation, which conducted an investigation in the city schools from the fall of 1913 to the opening of 1917, concludes its report, which will be distributed about Jan. 1, with the finding

ARTICLE IN NEW YORK GLOBE BASED ON REPORT OF NEW YORK STATE COMMISSION ON VENTILATION

An interesting item on the program was a paper on "Thickness of Insulation in the Refrigerating Field," by P. Nicholls, of the Research Laboratory of the American Society of Heating and Ventilating Engineers.

Among other papers of interest to heating engineers were those on "The Elasticity of Pipe Bends," by Sabin Crocker, piping engineer for the Detroit Edison Company, and Sterling S. Sanford; and "Orifice Coefficients—Data and Results of Tests," by J. M. Spitzglass.

The hearings on the A. S. M. E. Boiler Code included a session for the consideration of the requirements for low-pressure and heating boilers. One of the principal points brought up was in connection with the welding of seams. The welding interests took exception to the provision for preheating seams which were to be welded. Progress on the new steam tables was reported by George A. Orrok who stated that the new tables would be something that could be taken and used by any country. Both English and French engineers have already endorsed the work so far accomplished.

The newly-elected officers of the so-society are: President, John L. Harrington, of the consulting engineering firm of Harrington, Howard and Ash, Kansas City, Mo.; vice-presidents, William H. Kenerson, Walter S. Finley, Jr., Earl F. Scott and Henry H. Vaughan; managers, A. G. Christie, James H. Herron and Roy V. Wright; treasurer, William H. Wiley.

Portland's Electrically-Heated Apartment House.

Details which have reached us of Portland's new electrically-heated apartment house give some additional information concerning the unique equipment for this building. The apartment house itself, known as the Robison is located at East 23rd and Madison Streets, Portland, Oregon. It is a two-story building built last summer and consists of ten 2-room and two 3-room apartments.

The walls have been warmly constructed so as to prevent any unnecessary waste of heat from that source. The hallways in the building leading to the various apartments are heated by a pipeless furnace located in the basement. The hot water supplied to the apartments is heated by the same pipeless furnace which, by the way, uses briquettes for fuel.

Each apartment is equipped with an electric range and electric air heaters, no other form of heat being supplied. Any additional heat needed in the kichen is obtained through the oven element in the range. Each kitchen contains a breakfast nook and the room, with the nook, averages about 7 x 13½ ft. The bathroom averages 6 x 8 ft. and is heated by a 1000-watt portable heater.

The living room in each apartment averages about 12½ ft. x 13½ ft. and is heated by a 2000-watt electric heater. In the 2-room apartments a disappearing bed is installed, while in the 3-room apartments a bedroom, approximately 9 x 9 ft. is provided. This room is heated by the same 1000-watt heater used for the bathroom. The ceiling height of the room is approximately 8 ft 6 in.

Each 3-room apartment is equipped with an R-85 Hotpoint Hughes electric range while the 2-room apartments are equipped with C-4 Hotpoint Hughes electric ranges. The 1000-watt and 2000-watt electric heaters in the apartment are standard Westinghouse Type D air heaters, with three-heat control; they are operated on 120-volt service.

ROBISON ELECTRICALLY-HEATED APARTMENT HOUSE IN PORTLAND, OREGON.

Tenants of the Robison are operating on the standard residential tariff of Portland and the average bill for all electrical service for the month of October was $5.05. This was the first month of operation and one of the bills was a minimum bill, due to the fact that the tenant had only been in a short time. For the month of November, the average bill was $9.08. The minimum bill for the month for any apartment was $5.09 and the maximum, $12.69.

The installation, it is stated, is operating with entire satisfaction, both to the owner and to the tenants. The owner believed that by using electric heat he would be able to save the expense of a janitor, besides saving an appreciable amount in the redecoration of rooms and would be able to secure a higher class of tenants. In this way he figured he would be able to offer his apartment at a rental which would justify the tenants paying more for their heating than they would for the customary method.

A Restful Atmosphere as a Paying Proposition.

Basing his argument on the premise that health and comfort features dominate theatre essentials, G. C. Breidert, of the Ilg Electric Ventilating Company, Chicago, Ill., writing in *Theatre Equipment*, makes out a strong case in favor of the advantages of what he terms a "restful atmosphere." Declaring that the extravagant appeal made to the eye of patrons is out of proportion to the provisions for proper atmosphere, Mr. Breidert declares:

"All humanity is learning to shun the theatre that does not provide the utmost in comfort and correct ventilation. With due respect to modern architecture, attractive fixtures, furnishings and decorations, there is nothing so inviting to the theatre going public as fresh invigorating atmosphere.

"Thousands of dollars are spent yearly by theatre operators everywhere, large and small, for decorations, that is, interior decorations. Much of these decorations are unseen. Why?

"Is it not a fact that 75 per cent—we believe we are nearly right by using this figure—of a motion picture program is run off in the dark? Commercial men who have made a success in advertising and selling their product or service, generally appeal to the five senses of humanity; seeing, hearing, feeling, smelling or tasting. Since the theatre owners product or service is entertainment, it is of course necessary to appeal to the senses of hearing, seeing and feeling. The sense of hearing is satisfied by the musical program; the sense of seeing is satisfied by the pictures. The sense of feeling is satisfied by comfort entirely, and since one must sit through the program for several hours it is important that this be supplied.

SAYS COMFORT IS NEGLECTED.

"There is no question about the fact that most theatre owners are able to satisfy their patrons through the sense of sight and hearing, by pictures and musical programs. However, we maintain that too strenuous efforts are made to appeal to the sense of sight and a shameful lack of attention is given to the sense of feeling superinduced by restfulness and comfort. Has it ever occurred to you that so little money is spent on a ventilating system which indisputably provides for the comfort so essential during the greatest part of the program? The fact of the matter is, the greatest amount of money is spent for extravagant decorations which can only be seen the least part of the time, during intermissions or few minutes' glances at intervals. Does not this comparison show a lopsided expenditure?

"We believe we have justified the statement that a ventilating system should be seriously considered at any cost since it has to do with creating restful enjoyment and inducing the public to give preference to a theatre. Little has been said from the health standpoint as it is undoubtedly agreed that fresh air plays an important part in the program of life and that disease germs rapidly multiply and attach to persons of low vitality, especially in an atmosphere made unhealthy, not only by presence of a great number of persons in an enclosed room but by lack of ventilation in general.

"We have attempted to show thus far that the patrons' interest and enjoyment together with the exhibitor's own financial gain are served best by correct ventilation. Going further it can be safely stated that an irritable audience will make or break the reputation of both pictures and theatre.

URGES LOBBY VENTILATION.

"In any city it is not uncommon to see theatres with lobbies crowded with people. In almost every instance, it is necessary to stand in line or in a group, anywhere from five to thirty minutes before sufficient seating capacity is available for the waiting patrons. Somehow or other, theatre owners do not realize that this same group of people are suffering discomfort during their period of waiting through lack of fresh air in the lobby. In this part of the theatre, there is absolutely no provision for ventilation and why the owner should rest contented that he can stupefy his audience without reflection on either picture or program at the very outset, and irritate them for a period of from five to thirty minutes is beyond the comprehension of practically everyone who has suffered the experience.

"If the theatre owner were to mingle with the people in the lobby he would hear various remarks about discomfort and feeling of faintness. If a sample of the air were to be taken in the lobby which was crowded, it would be discovered that a stratum of air anywhere from the floor to a foot above the heads of the people was highly contaminated with carbon dioxide, while the air in the upper part of the room would be considerably purer. This, of course, depends upon whether the lobby is heated. In any event, heated or unheated, there would be a stagnant atmosphere which would cause a high degree of discomfort.

"An independent system of lobby ventilation is suggested. As a separate unit, this could be operating during the period when the lobby is crowded and shut off as soon as it was emptied. A system of this kind would not cost much and would help to send the patrons into the house entirely comfortable so that the program from beginning to end would be enjoyed."

Fuels Division of A. S. M. E. Publishes Revised Rules for Coal Conservation

Acting on the conditions brought about by the present fuel shortage, the Fuels Division of the American Society of Mechanical Engineers has gone over the various published directions for the economical burning of fuel and has just issued a revision of these rules, as follows:

Part I—Preparation of Equipment.

a. See that the grates are in good order.

b. Seal air leaks in ash pit and around clean-out doors.

c. Cover steam and water pipes to prevent unnecessary radiation.

d. Provide suitable clean-out tools for boiler flues.

e. Prepare for supplementary heat in mild weather, fireplaces, gas logs, kerosene heaters, etc.

f. Prevent air leakage as far as possible by weather strips and storm windows.

g. Provide for recirculating air in hot-air furnaces by convenient slides in the pipes.

h. Arrange coal bins so that two kinds of fuel can be kept separate, if desired.

Part II—Kinds of Fuel.

a. Stove and nut anthracite are ideal fuels for heating homes. Scarcity and cost of these fuels will restrict their use in the future. Small sizes of anthracite should be used whenever possible.

b. Gas coke in connection with anthracite pea or buckwheat coal. This is an excellent combination, as the fire will keep well, but will give heat when required.

c. Block wood in conjunction with anthracite pea or buckwheat coal. This is a good combination where wood is available, equal to coke for producing heat, but requiring more attention.

d. Bituminous coal can be used in most furnaces designed for hard coal. The exceptions will be found in cases where the flue passages are small and not easily cleaned. Bituminous coal demands more attention, and unless this is given will give less heat. Best results will be found where the furnace is rather large for the house, so that the fire does not have to be pushed.

Part III—Management of Furnace.

1. Rules for Burning Anthracite Coal (large sizes)

a. Carry a deep bed of fuel, at least level with fire doors.

b. Shake the grate to remove ashes and lower the fuel bed but stop when the first live coals appear.

c. Fresh fuel should be spread evenly, over the entire grate area. A heavy firing, say 6 to 8 in. deep, can be made if desired and will last for 6 to 8 hours. For quick kindling, the fire bed should be made fairly hot before adding fresh fuel.

d. After firing keep the dampers wide open until blue flame appears, then check off the draft as much as necessary to keep the fire burning at desired rate. The proper setting of the dampers must be learned by experience for each furnace; this is because of the variation in the draft available for different installations.

2. Rules for Burning Coke and Anthracite Pea or Buckwheat

e. Carry a deep bed of fuel, even above the level of the fire door.

f. Shake the grate to remove ashes and lower the fuel bed but stop when the first live coals appear.

g. Spread a thin layer of anthracite over the entire grate and allow a few minutes for this fuel to ignite. Next fill the fire pot with coke, and allow this to burn until blue flame appears, then add another layer of anthracite.

h. After firing and seeing that the charge is ignited, check off the draft to the desired point for slow burning.

i. When banking the fire for the night, use less coke and more anthracite, but otherwise fire in the same manner.

j. Anthracite pea or buckwheat can often be used alone with success. This will happen when the draft is unusually good and the furnace is amply large. Small-size anthracite ignites slowly. It is best to fire one-half of the grate at a time, allowing the first half of the charge to ignite before adding the second half. Small sizes may be used in the fall and spring if not in the winter.

3. Rules for Burning Wood and Anthracite Pea or Buckwheat

k. Follow the rules for coke and anthracite, substituting block wood for coke. It is highly important to see that the fuel is properly ignited and giving off flame before closing off the drafts.

4. Rules for Burning Bituminous Coal

l. Bituminous, or soft, coal will as a rule give out less heat than anthracite when fired in the ordinary residence heater. Hence more attention will usually be required when using soft coal.

m. A deep fuel bed is desirable, also, as a rule, more draft by the dampers.

n. After the fuel is partly burned, more heat can be obtained by breaking up the fire bed with the hoe or poker if the fuel bed is caked.

o. Stir up the fire and get it hot before adding new fuel.

p. Preliminary to firing a new charge, push the burned fuel to the back or sides of the fire-box, heaping it high up on the sides of the fire-box walls. Fire fresh fuel into the hole in the hot fuel bed, making it level with the heaped-up burning fuel.

q. After firing, check the draft to make the fire burn slowly, setting the dampers as found best by experience.

r. A large charge of soft coal will burn slowly for several hours, giving out moderate heat. If more heat is demanded it can be secured by breaking up the partly ignited mass with the fire tools.

s. A little air should be admitted through the slides in the fire door when burning bituminous coal.

Cancellation of Priority Orders.

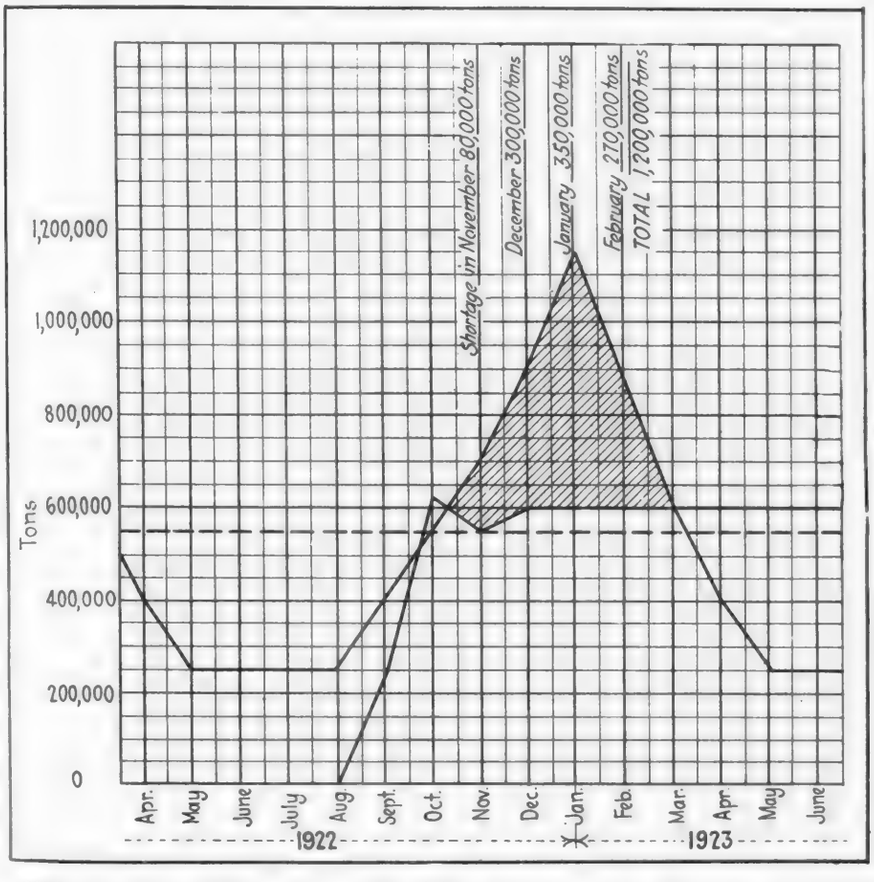
Notice issued by the Interstate Commerce Commission on December 7 was to the effect that beginning at midnight December 11, virtually all of the service orders then outstanding, which have given priority to the movement of coal since the strike, would be cancelled. The only restriction is a requirement that all shipments must be forwarded by the most direct routes, without regard to the normal traffic arrangements.

January Will Mark Crisis in New York City's Coal Plight.

The crucial point in New York City's coal shortage will be reached in January when the allotment of anthracite will fall 550,000 tons below the amount needed, according to figures of the estimated receipts which have been given out by New York State Fuel Commissioner Woodin. The shortage for December was 300,000 tons. This means that January's consumption of soft coal will have to be much larger.

The figures, based upon a comparison of the normal anthracite consumption, show that in January New York City ordinarily consumes 1,150,000 tons of coal.

A graphic picture of New York City's present and prospective shortage of anthracite is given in the accompanying diagram, prepared by the New York State Fuel Administration.



ESTIMATED RECEIPTS AND CONSUMPTION OF DOMESTIC SIZE ANTHRACITE COAL IN GREATER NEW YORK, 1922-1923.

Substitute Coal Order Issued in New York City.

Probably the most drastic action yet taken to conserve the hard coal supply in the metropolitan district is embodied in the order recently issued by Arthur S. Learoyd, district coal administrator for New York City, acting under the authority of New York State Administrator Woodin, requiring the use of 25% of substitutes by all consumers of domestic sizes of anthracite coal who buy their coal in 2-ton lots or larger. The order reads:

Each delivery of the sizes of anthracite known as grate, broken, stove, chestnut or range coal, where such coal is used for heating purposes and where the delivery consists of two tons or more, shall be preceded or accompanied by a delivery of not less than 25% of buckwheat, coke, bituminous coal or other substitutes. No delivery of less than one ton of substitutes is required under this order.

To meet the present emergency it is further recommended that whenever possible the minimum of substitutes of 25% be increased and that wherever practical substitutes be delivered with orders of less than two tons.

The Northern Institute Succeeds the Cleveland Engineering Institute.

A reorganization of the Cleveland Engineering Institute, which has for several years been conducting a correspondence course in heating and ventilating engineering, has been effected and the name of the school changed to the Northern Institute, with headquarters at 1951 East 57th Street, Cleveland, O.

Early last Spring the Educational Institute, which formerly operated the Cleveland Engineering Institute, made an assignment and a member of the present organization purchased the complete assets and continued to furnish instruction to the students without a break throughout the summer. The school "marked time" all summer as far as new developments were concerned and finally, on November 1, was incorporated under its new name. This incorporation has served to strengthen the former organization with increased capital and business talent, rather than to create any radical changes.

The present officers are: President, George W. Roberts, a well-known heating and ventilating engineer and a member of the A. S. H. & V. E.; vice-president and general manager, K. L. Seelbach, a member of the American Society of Mechanical Engineers; secretary, Henry F. Pollock, formerly vice-president of the McCaskey Register Company; treasurer, W. L. Seelbach, of the Walworth Run Foundry Co. In the instruction department Mr. Roberts remains as director and Earl A. Davis as chief examiner.

Heating Methods of the Future Discussed by Illinois Chapter.

A look into the heating methods of the future was afforded the members of the Illinois Chapter in the presentation of a paper by Samuel R. Lewis, at the Chapter's November meeting, on "A New Scheme for Group Heating of Buildings." Fifty-seven members and guests were present at the Chicago Engineers' Club November 13, when President Nelson called the meeting to order.

Mr. Lewis's scheme proved to be radically different from anything heretofore presented and was considered one of the most striking ideas ever discussed by the chapter. Briefly, his plan contemplated the erection of a large enclosure one-half mile square and 100 ft. high. Within this enclosure could be built 16,000 apartments, with a total population of approximately 65,000 people, or a corresponding smaller number of individual dwellings.

The structure of the enclosure would be such that the heat loss would be cut to a minimum so that an average of 50 sq. ft. of radiation would be all that would be required for each six-room apartment. Numerous schemes for temperature, humidity and weather control were brought up during the discussion which was entered into by Messrs. Kehm, Heckel, Davis, Hill, Newport, Small, Spurling, Howatt and Linn.

The project, it developed, is so vast that it was almost impossible to grasp all the possibilities of the scheme, but the consensus of opinion was that the plan had considerable merit, although probably 100 years ahead of time.

American Society of Heating and Ventilating Engineers

Plans for Annual Meeting.

Six sessions are scheduled at the forthcoming meeting of the American Society of Heating and Ventilating Engineers, January 23-26, 1923. To comply with the requirements of the constitution, the first session will be held in New York, at 10 A. M., January 23, at the Engineering Societies Building, 29 West 39th Street. At this session committee reports and other routine business will be handled. Following this session the meeting will adjourn to Washington, D. C., where headquarters will be established in the Washington Hotel, on Pennsylvania Avenue, at Fifteenth Street.

The five remaining professional sessions will include one all-day meeting, on Wednesday, January 24, at the U. S. Bureau of Standards, the morning to be devoted to Bureau of Standards papers and the afternoon to an inspection of the laboratories. The day will conclude with an evening session at the hotel headquarters, when papers of local interest will be presented. The research session will be held on Thursday, the 25th, with the annual banquet in the evening. Two professional sessions will be held on Friday, the 26th, at the hotel, one devoted to heating and the other to ventilation.

Among the matters of special importance to come before the meeting are the report of the Committee on Standard Code for Installation of Warm-Air Furnaces in Residences, and the proposed revision of the constitution. The warm-air furnace code which will be submitted is practically a minority report of the committee representing various organizations, which has been at work on this subject. The majority report of this committee was adopted some time ago by all of the associations interested, with the exception of the American Society of Heating and Ventilating Engineers, and was ordered printed and distributed.

Chapter Organized in Wisconsin.

Fourteen Wisconsin members of the American Society of Heating and Ventilating Engineers have organized a Wisconsin Chapter of the society and have applied to the council for a charter. The organization meeting was held November 14 at the City Club, Milwaukee. C. W. Miller was elected temporary chairman and H. L. Williams, temporary secretary.

Organization of Columbus Chapter.

A Columbus Chapter of the American Society of Heating and Ventilating Engineers was organized December 15 at the Ohio State University, Columbus, O. Those interested met at a turkey dinner on that date, adjourning later to the Mining Building to take up the matter of organization.

F. H. Valentine, president of the Cleveland Chapter of the A. S. H. & V. E. took the chair and stated the purpose of the meeting. In his remarks he pledged the assistance and cooperation of the Cleveland Chapter for the new organization. Organization was then effected by the election as Temporary Chairman of C. F. Babbett. The Columbus Chapter starts with 11 full members.

Dean Anderson, director of the A. S. H. & V. E. Research Laboratory, who was to be the principal speaker of the evening, was detained by illness. Among those present were President J. R. McColl, of the American Society of Heating and Ventilating Engineers, and the following Pittsburgh Chapter members: President Edwin C. Evans, F. C. McIntosh and Lee Phillips. Cleveland was represented by President F. H. Valentine of the Cleveland Chapter and M. F. Rather, H. M. Nobis, J. W. Farley and F. D. Rollins.

The Columbus men present were: J. M. Grimm, E. A. Hitchcock, H. A. Erickson, William H. MacKenser, E. L. Anderson, F. A. Richards, Alfred Barr, Professor A. I. Brown, C. C. Loder, C. F. Babbett and Master E. E. Babbett.

New York Chapter Given Description of Cornell University's Central Heating Plant.

A remarkable presentation of the engineering features of a modern central heating plant for a group of institutional buildings was made at the December meeting of the New York Chapter, at the Building Trades Employers' Club, December 18. George B. Nichols, formerly engineer for the New York State Department of Architecture and now with Henry R. Kent & Company, gave a detailed description of the extensive central heating plant recently completed under his supervision at Cornell University, in Ithaca, N. Y., and supplemented his talk with numerous slides, showing not only the principal features of the system, but various stages of the work as it progressed.

Mr. Nichols said that the tendency was towards larger institutional plants than was considered practicable a few years ago and that while the limit of accommodations used to be placed at from 2000 to 3000 people, the newer institutions were now taking care of from 6000 up to 15,000 persons.

As a general basis for figuring, he said, it was the practice to consider an average of 500 people as the limit that could be taken care of by each individual heating plant, so that in the case of a large institution it was customary to divide the system into units of that capacity. To figure the probable coal consumption in such a plant, it could be estimated at four tons per year per inmate. He advocated keeping heat on all the time. Cartage of ashes can be estimated as costing $1.00 per ton and, with 24-hour operation, a force of nine men would be needed at each plant.

The heating plant at Cornell, he said, has a total capacity of 4000 H. P. and the connected radiation amounts to 400,000 sq. ft. Owing to the fact that a pressure of 100 lbs. is required in the Chemistry Building, located nearly a mile away from the power plant, a pressure of 150 lbs. and over is carried in the mains.

Numerous views were presented of the underground conduit construction, the conduits being built of split tile. A unique feature of the installation is that all the piping is acetylene welded and Mr. Nichols expressed his approval of this method, providing care was taken in the selection of the welders. The cost of welding, he said, could be estimated at 75 cents per inch of diameter. Views were also shown of pipe tunnels at other institutions in which flanged pipe was used and Mr. Nichols declared that if he had it to do over again he would use welded pipe. Many of the photographs displayed gave a very clear idea of the process as employed at Cornell, the welding being done after the pipe was in place. In answer to inquiries as to how the welders were able to get at the bottom of the connections, Mr. Nichols said all the welding was done at the top and the pipe turned as the work proceeded so as to bring the fresh surfaces to the top. Pipe lengths of 40 ft. were used which helped to effect a saving. Also all of the pipe installed was of steel, which was used on the recommendation of the university engineering staff.

The different methods of caring for expansion were shown and the comment was made by the speaker that the commonly-accepted data appearing in handbooks for pipe loops could not be depended upon. For more accurate data he referred his hearers to the tables and formulas prepared by Ralph T. Taggart and presented some years ago before the civil engineers' society. (Mr. Taggart's data were presented in THE HEATING AND VENTILATING MAGAZINE for September, 1910).

In the absence of President Carrier, Vice-President W. L. Durand presided at the meeting. Chairman George G. Schmidt of the Membership Committee reported an increase in the chapter's roll, bringing the total to over 150 members. Charles V. Haynes told of the plans for the society's annual meeting in Washington, stating that the New York Chapter's Washington entertainment fund had reached over $500.00.

The presence of President C. W. Farrar of the Western New York Chapter was noted by Chairman Durand and Mr. Farrar responded by urging a wider interest in the society's activities through a still greater increase in the membership of the society.

Plans for the January meeting of the Chapter were discussed by James A. Donnelly and it was voted to make this meeting a booster for the annual meeting of the

society immediately following in Washington.

William H. Driscoll also addressed the meeting in behalf of the regular ticket of the nominating committee for officers of the A. S. H. & V. E. Over 80 members and guests were present.

Manufacturing and Firing of Coke Discussed by Western New York Chapter.

H. C. Lauber, of the Seaboard By-Product Coke Company, was the principal speaker at the December meeting of the Western New York Chapter, held at the Hotel Iroquois, Buffalo, December 4. Mr. Laubers' talk was along the same lines as his address in October before the New York Chapter on "Manufacturing and Firing of Coke." He explained the differences in various kinds of coke, and then took up its manufacture, methods of firing and its efficiency as compared with other fuels. Moving pictures were then shown of the process of coke manufacture as carried on at the plant of the Seaboard By-Product Coke Company, in Jersey City, N. J.

President C. W. Farrar appointed the following committee to nominate officers for the ensuing year: Herman Worsham, chairman; Louis A. Harding and G. M. Maier.

Talk on Heating Calculations Before Philadelphia Chapter.

Under the general topic of "Calculation of Heating Requirements," John M. Sewall and H. K. Brown discussed the principal methods in common use, at the December meeting of the Philadelphia Chapter, in Philadelphia, December 14. Mr. Sewall spoke particularly of the radiation method so-called, while Mr. Brown's talk was devoted to the infiltration method. Blueprints, giving the outline of a building and detail figures used in calculation were passed around, and Mr. Sewall explained in detail the method of arriving at the results by his method. Using the same building outline, Mr. Brown explained the infiltration method in detail, and a tabulated comparison of the two methods was placed on the blackboard. An interesting discussion followed, concluding with a rising vote of thanks to the two speakers.

Seventy-five members were present at the dinner preceding the meeting and this number was later augmented to 115. During the preliminary session, a report was presented by the special committee appointed to formulate constructive criticism of the A. S. H. & V. E. Guide, for the benefit of the committee working on the 1923 edition.

After further routine business, the meeting was turned over to the Meetings Committee.

Illinois Chapter Has a "Stunt Night."

"Trouble Encountered on Jobs" was a subject which attracted nearly 70 members and guests of the Illinois Chapter to its December meeting, held December 11, at the Chicago Engineers' Club. Joseph A. Cutler acted as chairman of the "stunt" program, and called upon a number of speakers for answers to the query: "Did you ever get up against trouble on a job where you had no precedent to show you what to do?"

Harry M. Hart was the first to take the floor and drew a number of diagrams on the blackboard to illustrate his discussion of low-pressure boiler connections to prevent foaming and other troubles. After a lively discussion, James Hayes, of the American Steam Pump Company, gave a talk on steam pumps and the various troubles experienced in their use.

Kitchen ventilation came in for attention on the part of G. C. Breidert, sales promotion manager for the Ilg Electric Ventilating Company, who showed a number of views of kitchens equipped with ventilating fans, stating that there was a market for 80,000 such devices in Chicago alone.

Homer Linn, of the American Radiator Company, talked on the subject of chimneys, this topic being further discussed by William Graves and John Chubb, of the Whitlock Coil Pipe Company.

John Howatt, chief engineer for the Chicago Board of Education, gave an interesting account of the heating problems encountered in connection with public school work.

American Society of Mechanical Engineers Adopts National Code of Ethics

One of the important actions taken at the recent annual meeting of the American Society of Mechanical Engineers was the adoption of the code of ethics compiled by a joint committee of which Professor A. G. Christie of Johns Hopkins University was chairman, representing the principal engineering societies, including the American Society of Heating and Ventilating Engineers.

THE CODE

Engineering work has become an increasingly important factor in the progress of civilization and in the welfare of the community. The engineering profession is held responsible for the planning, construction and operation of such work and is entitled to the position and authority which will enable it to discharge this responsibility and to render effective service to humanity.

That the dignity of their chosen profession may be maintained, it is the duty of all engineers to conduct themselves according to the principles of the following Code of Ethics:

1. The engineer will carry on his professional work in a spirit of fairness to employees and contractors, fidelity to clients and employers, loyalty to his country and devotion to high ideals of courtesy and personal honor.

2. He will refrain from associating himself with or allowing the use of his name by an enterprise of questionable character.

3. He will advertise only in a dignified manner, being careful to avoid misleading statements.

4. He will regard as confidential any information obtained by him as to the business affairs and technical methods or processes of a client or employer.

5. He will inform a client or employer of any business connections, interest or affiliations which might influence his judgment or impair the disinterested quality of his services.

6. He will refrain from using any improper or questionable methods of soliciting professional work and will decline to pay or to accept commissions for securing such work.

7. He will accept compensation, financial or otherwise, for a particular service, from one source only, except with the full knowledge and consent of all interested parties.

8. He will not use unfair means to win professional advancement or to injure the chances of another engineer to secure and hold employment.

9. He will cooperate in upbuilding the profession by exchanging general information and experience with his fellow engineers and students of engineering and also by contributing to work of engineering societies, schools of applied science and the technical press.

10. He will interest himself in the public welfare in behalf of which he will be ready to apply his special knowledge, skill and training for the use and benefit of mankind.

The Riccio Foot-Operated Radiator Valve.

How easily the foot-operated radiator valve designed by P. A. Riccio may be operated is shown in the accompanying illustration. This valve was illustrated and described in THE HEATING AND VENTILATING MAGAZINE for November, 1922. The ingenious feature of the valve is the catch with which it is provided to hold down the spindle when the foot is removed.

OPERATION OF RICCIO RADIATOR VALVE.

Portable Unit Ventilators

2—The Peerless Unit System.

A type of unit ventilator with some characteristic distinguishing features is the Peerless heating and ventilating unit, manufactured by the Peerless Unit Ventilation Co., Inc., 437-439 West 16th Street, New York. Perhaps its most noticeable feature is the use of specially-designed Vento radiators. Being entirely enclosed in a cabinet of furniture-steel, and finished in olive green, the unit has a compact appearance which is borne out by an inspection of its construction.

As is usual with this type of ventilator, the unit is arranged to admit fresh air from out-of-doors, the exact form of fresh air intake depending in each instance upon the building construction at the point of application. The fresh air is taken in at as high a level as possible to prevent dirt, leaves, etc., from being drawn in. As an extra precaution, the inlet is covered with a screen or grille.

The air is circulated by a special constant-speed motor with extended shafts on which are mounted two aluminum multi-blade fans. These fans are arranged to operate at a speed not exceeding 900 R. P. M.

The Vento radiator used is built to the company's own design and is located in the heating chamber. There is also a water reservoir in the bottom of the cabinet which acts as a deflector to the incoming air, at the same time removing dust and dirt and humidifying the air. The amount of solid matter caught in this reservoir is realized when the reservoir is removed for cleaning. If desired, the reservoir may also be used as a place for applying deodorizers or disinfectants, a feature often utilized in hospitals and sick rooms. After being heated and purified, the fresh warmed air is delivered from an opening in the face of the unit and directed toward the ceiling. For disposing of the vitiated air, an exit grille is located near the floor and passes through a flue or directly to the outside of the building.

Recirculation of the air through the ventilator is provided for through a recirculating intake consisting of a full-length hinged door on the top of the unit. A grille is fastened inside the cabinet and painted to match the exterior finish to prevent foreign matter from entering at this point. The fresh air inlet has louvre dampers so connected with the recirculating door in the top of the unit that the opening of one has a corresponding opposite effect upon the other. The manufacturers also direct attention to an additional or air-mixing damper, operated by hand or automatic control, which permits a wide range of temperature regulation, from the point at which all of the incoming fresh air passes through the radiator, to the other extreme point where all of the incoming fresh air is driven through the by-pass without coming into contact with the radiator.

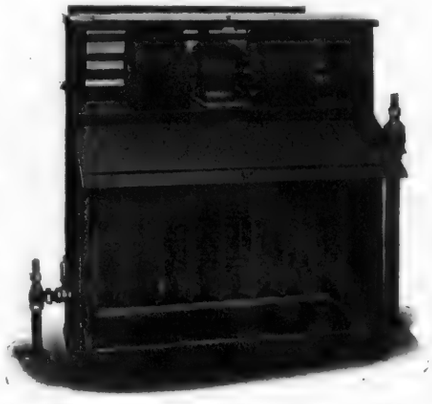
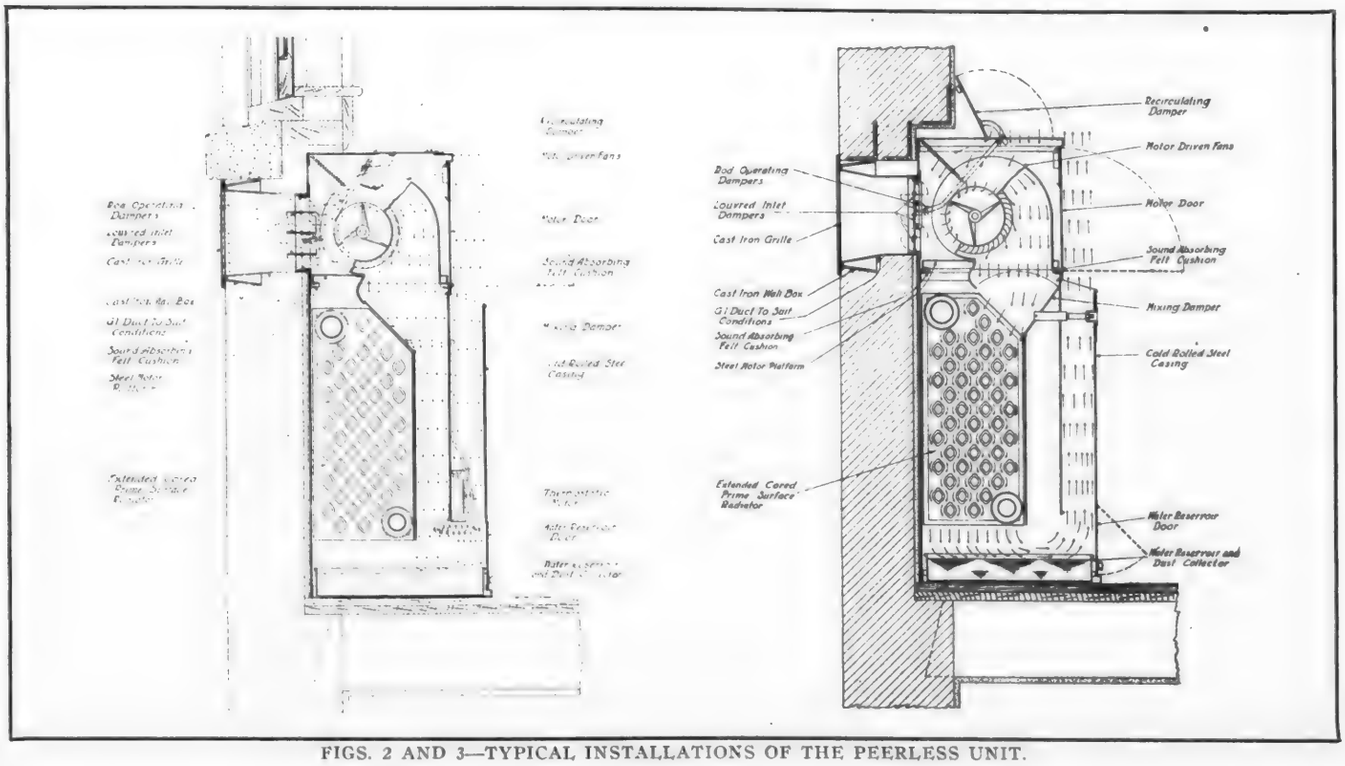


FIG. 1—PEERLESS HEATING AND VENTILATING UNIT.

All air passes through the unit and also, under all conditions, all of the air passes over the water in the water pan. The radiator valves are kept open to assure ample steam supply and are provided with lock shields and key to prevent tampering. Manipulation of the radiator valves it is pointed out, is neither necessary nor desirable, as all control of the room temperature is obtained by the air-mixing damper. With the damper in the cold position and outside air at between 60° and 70° F., the Peerless unit, according to the manufacturers' guarantee, is able to pass all the air around the radiator in the unit and discharge it at a temperature rise not exceeding 5° F.

Either hand or automatic control may be used with the air mixer. With hand control, a plate is placed on the face of the cabinet to indicate the direction of movement and the damper position for securing the various temperature conditions. Automatic control is secured by means of a diaphragm motor inside of the cabinet controlling the mixing damper. A two-point compound thermostat operates the damper motor and the valves on the auxiliary direct radiation.



FIGS. 2 AND 3—TYPICAL INSTALLATIONS OF THE PEERLESS UNIT.

Sound and vibration-absorbing felt cushions are fitted to the steel platform, on which are mounted the motor and fan, to secure noiseless operation. Care has also been taken to use direct-current motors so as to eliminate all magnetic motor noises.

DIRECTIONS FOR LAYING OUT SYSTEM.

First determine the amount of air required for ventilation, figuring on 30 cu. ft. per minute per pupil in the classrooms, and from four to six changes per hour for such rooms as assembly halls and gymnasiums. The size of units having been decided on from the above information and from the accompanying table, the location of the unit and the method of making the fresh-air inlet should be determined

To determine the amount of direct radiation required, the radiation is computed in the regular way and then the amount shown in the table for the particular unit chosen should be deducted. The remainder is the amount that must be added in direct radiation. The manufacturers recommend the installation of separate direct radiation so that if the electric current should be shut off and the fan kept out of operation the room can still be heated. It is pointed out that the unit itself does not contain enough radiation

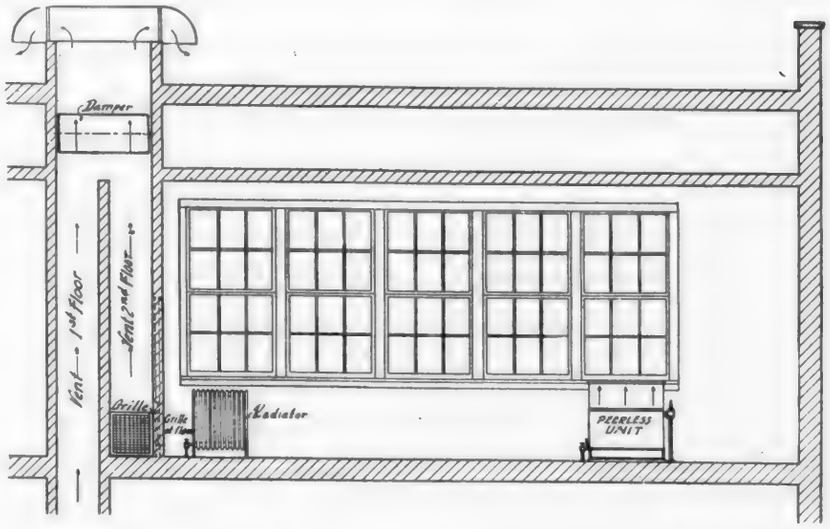


FIG. 4—TYPICAL LOCATIONS OF PEERLESS UNITS AND VENTS IN SCHOOLROOMS.

described as the most satisfactory way of venting classrooms. The second method is venting through independent flues in the classrooms. In the third method, especially where buildings have no provision for mechanical ventilation, the venting may be through the corridor and into a main vent flue located in the corridor. However, in some states, this would not meet the legal requirements.

A Correction.—The title of the first article in this series was inadvertently given as "Univent Unit Heaters." This should have read "Univent Unit Ventilators."

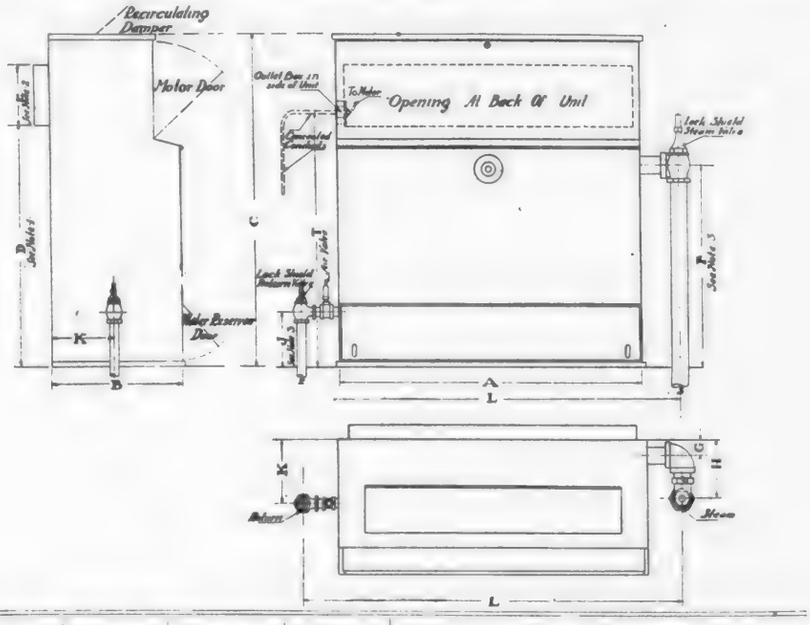
DATA ON PEERLESS UNITS FOR DELIVERY OF STATED QUANTITIES OF AIR AND MAINTAINING 70° F. ROOM TEMPERATURE, WITH STEAM AT 5 LBS. GAUGE.

Unit Number	Entering Air at 0 Deg. Fahr.				
	Cubic Feet of Air per Minute	Final Temp. Deg. Fahr.	Total B.t.u.	Direct Radiation to be Omitted	Condensation Pounds per Hour
720	600	88	63360	51	66.0
	700	83	69720	43	72.2
	800	77	73920	26	77.0
	900	72	77250	6	80.5
724	600	99	71280	83	74.3
	700	93	78120	77	81.4
	800	88	84480	58	88.0
	900	83	89600	55	93.4
920	900	86	92880	68	96.8
	1000	82	98400	56	102.5
	1100	78	102960	42	107.3
	1200	74	106000	20	110.5
924	900	95	102600	108	106.9
	1000	91	109200	100	113.7
	1100	87	114840	09	119.6
	1200	83	119500	74	124.5
1120	1200	84	120960	80	126.0
	1300	80	124800	62	130.0
	1400	76	127680	40	133.0
	1500	72	128700	10	134.1
1124	1200	92	132480	126	138.0
	1300	88	137280	112	143.0
	1400	84	141120	94	146.9
	1500	80	144000	72	150.0

to heat the average-size classroom when the fans are inoperative, having about the same usefulness as 75 sq. ft. of direct radiation.

Three methods of venting are suggested. In the first method venting is accomplished through an independent flue, usually located in the cloakroom. This is

SIZES, CAPACITIES AND DIMENSIONS OF THE PEERLESS HEATING AND VENTILATING UNIT.



Unit Number	Cu. Ft. Air per Min. Note 4	Final Temperature Note 4	Total B.t.u. Note 4	General Dimensions Notes 1 and 2				
				A	B	C	D	E
720	900	72°	77250	33″	18⅛″	42″	29½″	8″
724	900	83°	89600	33″	18⅛″	46″	33½″	8″
920	1200	74°	10600	42″	18⅛″	42″	29½″	8″
924	1200	83°	119500	42″	18⅛″	46″	33½″	8″
1120	1500	72°	128700	51″	18⅛″	43″	29½″	8″
1124	1500	80°	144000	51″	18⅛″	47″	33½″	8″

Unit Number	Steam Supply Notes 3 and 5			Return Notes 3 and 5			Pipe Sizes			Size F. A. Duct	Size Wall Box
	F	G	H	J	K	L	R	S	T		
720	24″	2⅛″	See Note 6	7½″	8¾″	43½″	1″	1½″	31″	10″x30″	10″x30″
724	28″	2⅛″		7½″	8¾″	43½″	1″	1½″	35″	10″x30″	10″x30″
920	24″	2⅛″		7½″	8¾″	52½″	1″	2″	31″	10″x40″	10″x40″
924	28″	2⅛″		7½″	8¾″	52½″	1″	2″	35″	10″x40″	10″x40″
1120	24″	2⅛″		7½″	8¾″	61½″	1″	2″	31″	10″x50″	10″x50″
1124	28″	2⅛″		7½″	8¾″	61½″	1″	2″	35″	10″x50″	10″x50″

NOTE 1.—Dimension D is the minimum and can be increased to suit height of window.
NOTE 2.—Dimension E is the inlet collar on back of unit. Duct connecting to this collar should be 10 inches deep.
NOTE 3.—Dimensions F and J are to bottom of unit. Dimensions to floor will vary with window heights and floor levels.
NOTE 4.—Final temperature can be increased by cutting down cu. ft. of air per min. This will change total B.t.u.
NOTE 5.—Steam connection on right hand side of unit, return connection on left hand side. This can be reversed where building conditions render necessary.
NOTE 6.—F = 2½″ + distance from center of ell to center of valve used.

National Trade Extension Bureau

Making Business More Profitable.

An argument for better accounting methods on the part of heating contractors and plumbing dealers through the use of the bureau's short course in accounting is advanced by the National Trade Extension Bureau in the statement that unless a firm can honestly say "yes" to the following questions, and many others, they are operating their business like a ship without a chart. They may have reached one port of success, yet the next voyage may be fatal. As the captain of your good ship, you are only certain of your shoulder bars, by having at your command ready information that will enable you to answer the following questions in the affirmative:

Do you know just how much you made or lost on each separate job or contract during the last year? Do you know how much your overhead cost you on each of these? Do you know just what items should be charged to overhead? Do you know which branch of your business is producing the most profit? Do you know where and how your business can be improved?

1923 Calendar of T. E. B. Advertising Campaigns has been published by the National Trade Extension Bureau, giving the titles of the various campaigns and the months in which they will be carried on. The bureau's Monthly Service Bulletin, a month in advance each time, it is stated, will contain further details of each drive.

ONLY a U. S. Mint can make money nowadays without putting forth real selling activities! T. E. B. has planned a practical selling campaign for every month of 1923. The Monthly Service Bulletin, a month in advance each time, will bring you in detail a host of selling ideas and a wealth of ready-to-use material. Every Plumbing Dealer or Heating Contractor will find it profitable to prepare for and carry out these ideas. It's the one and only sure way to kill off bad competition. The full service will provide a continuous selling plan for a successful year. Hang this Calendar where you're sure to see it daily; and plan for a year of real selling with real profit. Your selling activities should be continuous; but the dates printed in red are indicated for special, intensive selling effort on the campaign for that month.

THE NATIONAL TRADE EXTENSION BUREAU, EVANSVILLE, INDIANA

The National Trade Extension Bureau recently sent out a questionnaire to about 1000 newspapers soliciting information as to the amount of newspaper advertising done by heating contractors and plumbing dealers; individually and collectively in 1920, 1921 and 1922. Details were requested as to the amount of space, the number of insertions and, in the case of individual advertisers, the number of individuals. These details were requested for all three years.

As soon as sufficient time has elapsed, the replies received will be summarized and the figures combined in a manner to show a comparison of acivities within the trade along these lines.

Expansion of Excelso Specialty Works.

Important changes announced in the organization of the Excelso Specialty Works, Buffalo, N. Y., manufacturer of the Excelso water heaters and the Excelso rotary saws, indicate the rapid increase in the business of this company.

Following the announcement last month that the company had appointed "Lu" H. Drury of Chicago as associate of C. N. Stedman, the company's Chicago district manager, the company now announces the appointment of Cecil W. Farrar as vice-president and general manager of sales.

Mr. Farrar started his business career

C. W. FARRAR.

in 1905 with the American Radiator Company in the minor capacity of office boy. From the experience gained in the manufacturing end he was transferred to the sales end and became one of the youngest representatives, at that time, in the employ of the company. In 1911 Mr. Farrar became associated with the newly-formed United States Radiator Corporation as a special representative. Later he took charge of specialty sales and in more recent years has acted as manager of the company's Buffalo branch. At present Mr. Farrar is president of the Western New York Chapter of the American Society of Heating and Ventilating Engineers.

In a statement issued by Calvin P. Wadley, president of the Excelso Specialty Works, he states that the association of Mr. Farrar will give the company an opportunity to make the necessary expansion to meet the increased demand for its products.

New Apparatus and Appliances

New Type of Electric Steam Generator.

Recent studies in the central station electric field and in certain industrial centers, which have resulted in the development of electric steam generators, has led to the design of such a heater by the Genral Electric Co., Schenectady, N. Y. This heater has been found to be a successful means of utilizing excess power from hydro-electric plants, and also for "ironing out" load curves in pulp and paper mills and for using surplus energy from water-power plants to produce steam for heating and process work. Many of them, it has been found, have surplus electrical energy throughout the day, as well as on Sundays and holidays, which can be turned to good account in this manner.

In the General Electric equipment which has been designed to meet the requirements of simplicity, safety and reliability, power is required at the approximate rate of 1 K. W.-hour for every 3 lbs. of steam generated.

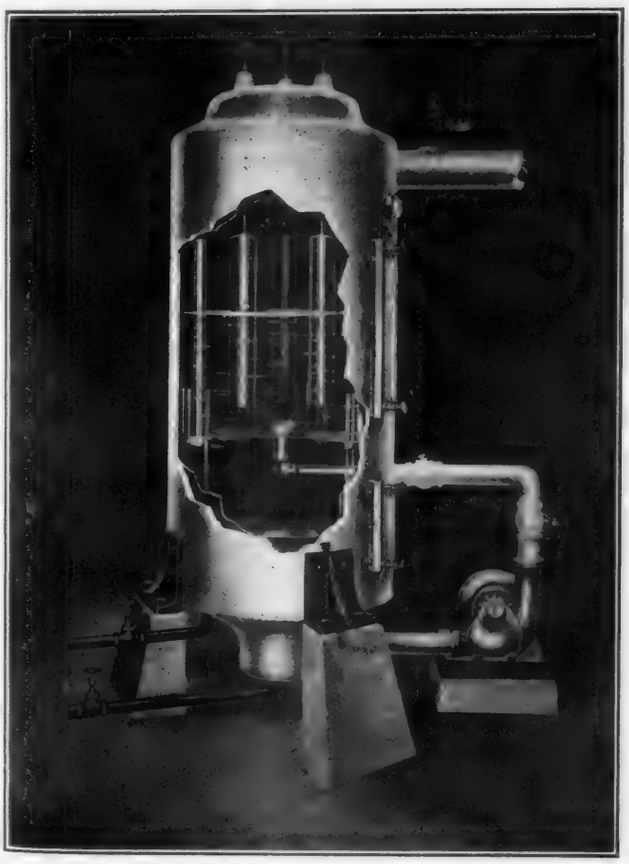
As described by E M. Horstkotte, of the Power and Mining Department of the General Electric Company, in *Power* for November 21, the complete equipment consists of the shell with supporting feet, the electrodes, insulators, steam and water gauges, safety valve, circulating pump and motor, and a panel on which is mounted the control equipment. The tank, or generator shell, is mounted vertically and divided horizontally into two compartments, the upper known as the electrode compartment, where the actual generation of steam takes place, and the lower forming a self-contained hot well. Water entering the hot well from the feed-water pipe is forced into the upper chamber by the motor-driven centrifugal pump located on a short external pipe line. From this chamber it flows back into the hot well through a number of small pipes on the outer circumference of the dividing plate. This arrangement provides a continuous circulation of heated water, the water level in the electrode chamber being held at the desired level by setting the valve in the circulating pump discharge line. The lower pipe at the left is the blow-off and the one just above is the feed-water

The upper, or electrode chamber, where the steam is generated, contains three large round iron electrodes rigidly supported from the roof, the current-carrying supporting rods coming in through specially designed insulating bushings. These bushings are provided with a small duct in the top leading to the outside air. Thus if steam does succeed in leaking through the packing into the upper section of the bushing, it passes out freely instead of creating a pressure that might blow out the side of the insulator.

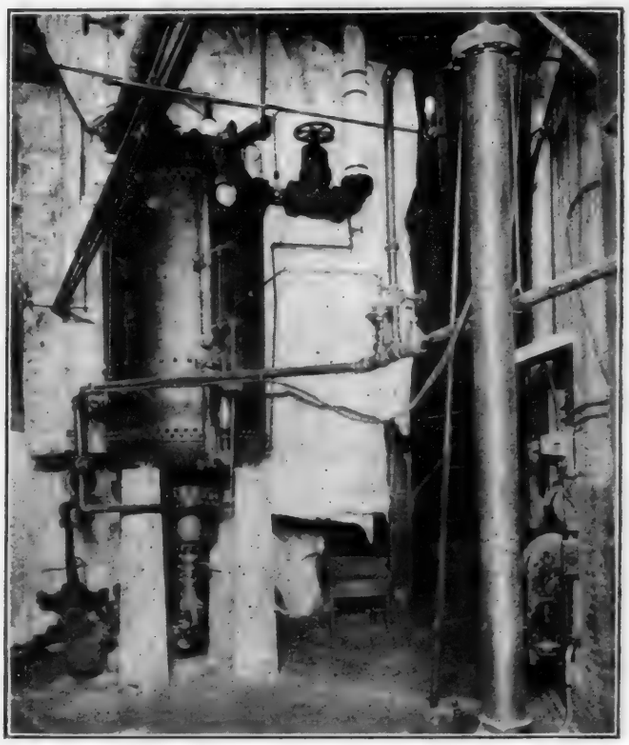
The electric operation somewhat resembles that of a three-phase arc furnace. Normally the electrodes are submerged in the water, and the three-phase current passes through the water to the sides of the tank and to the neutral of the system, also from electrode to electrode. The steam is generated by current flowing through the water, which is of high resistance. The mechanical circulation of the water has been described, but some of the operating features arising from it are of sufficient interest to merit further description One result is that the temperature of all the water in the system is practically uniform. If the steam pressure lowers owing to an increased demand, rapid steam generation, due to the high temperature of the water and the degree to which the electrodes are submerged, quickly brings the pressure up again.

Another operating feature is that since the water level is maintained by the adjustment of the throttle of the circulating pump, the energy consumption of the generator is not dependent on the operation of the feed-water pump. The supply of water in the hot well is regulated by an automatic feed-water regulator. Furthermore, when it is desired to reduce the load, the generator does not have to be blown. The only energy losses in the circulating-pump operation are the motor losses and the bearing friction losses. Practically all the energy delivered to the pump impeller goes into heat in the water, therefore, the loss from this source is small.

There is no difference in pressure between the hot well and the steam-generating chamber, as these are connected together by openings for taking care of excess water in the upper chamber. In case the water level in the upper chamber is



CONSTRUCTION OF NEW ELECTRIC STEAM GENERATOR.



TYPICAL INSTALLATION OF NEW ELECTRIC STEAM GENERATOR.

higher than that for which the boiler is designed, this level is automatically maintained at some maximum point and the excess water will flow through the openings referred to. This eliminates all danger of submerging the porcelain insulators and prevents overloading the boiler by high-water level.

In the high-voltage boilers—that is, for approximately 6,600 volts—the electrodes are arranged so that current passes from electrode to electrode and also from electrode to the inside basket, which serves as a neutral point. An inside basket is used instead of the boiler shell so that the latter will carry very little current. In the low-voltage boilers all the current flows from the electrode to the basket In this type of installation the electrodes consist of flat plates and the basket consists of two concentric sheets of iron properly spaced with the electrodes in between them. The basket then forms a neutral point and also a ground to the boiler shell. Any type of electric boiler will make a high-resistance ground on the system, due to the boiler's inherent construction, except where the heating elements are installed as in some small types using direct-current

These electric steam generators have been designed for pressures ranging from 200 lbs. maximum to 15 lbs. minimum. Tentative layouts have also been made on generators of 3,000 K. W. capacity operating at 1 lb. pressure. These generators can be designed for any boiler pressure now being used, up to 50,000 K. W. capacity and down to 250 to 300 K. W. Below this lower limit generators of this type would probably not be as economical to build as some sort of immersion-type using a metallic resistor.

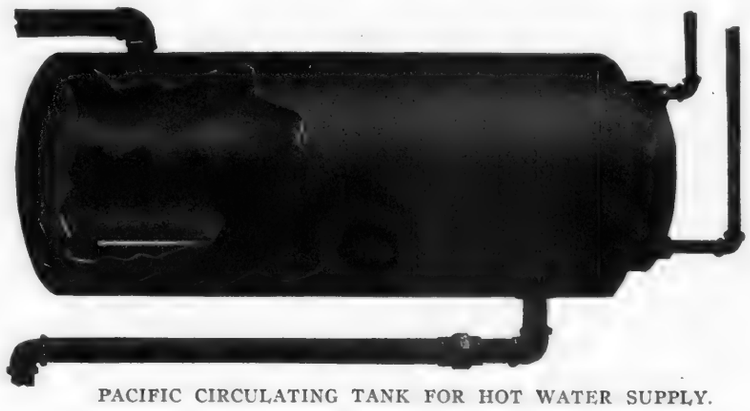
The safety factor, it is stated, is even higher than that of the average boiler. In addition to the safety valves which take care of excess pressures, and the method of protecting the insulators, further contingencies are taken care of by what may be described as the interlocking of the various devices.

Pacific Circulating Tanks.

Pacific steel circulating tanks, suitable for use in connection with any steam or water boiler, for providing hot water for domestic service during the winter, have been brought out by the General Boilers Co., Waukegan, Ill., and described in one of the company's recent bulletins (No. SC 22). With these tanks during the summer time it is only necessary to fire the boiler once or twice daily to furnish hot water for 24 hours.

The principle of operation of the Pacific circulating tank may be understood when it stated that the outfit is merely a tank within a tank. Hot water is drawn from the inner tank which is heated by hot water from the boiler circulating around it in the outer tank. Pacific tanks are designed to serve the same purpose as tank heaters as well as coils in the firebox. They are described as easy to install, while their cost is but little more than that of an ordinary hot water storage tank.

These tanks are built of steel, electrically-welded; they are leak-proof without caulking. Pacific circulating tanks are made in various sizes having capacities from 50 to 550 gal.



PACIFIC CIRCULATING TANK FOR HOT WATER SUPPLY.

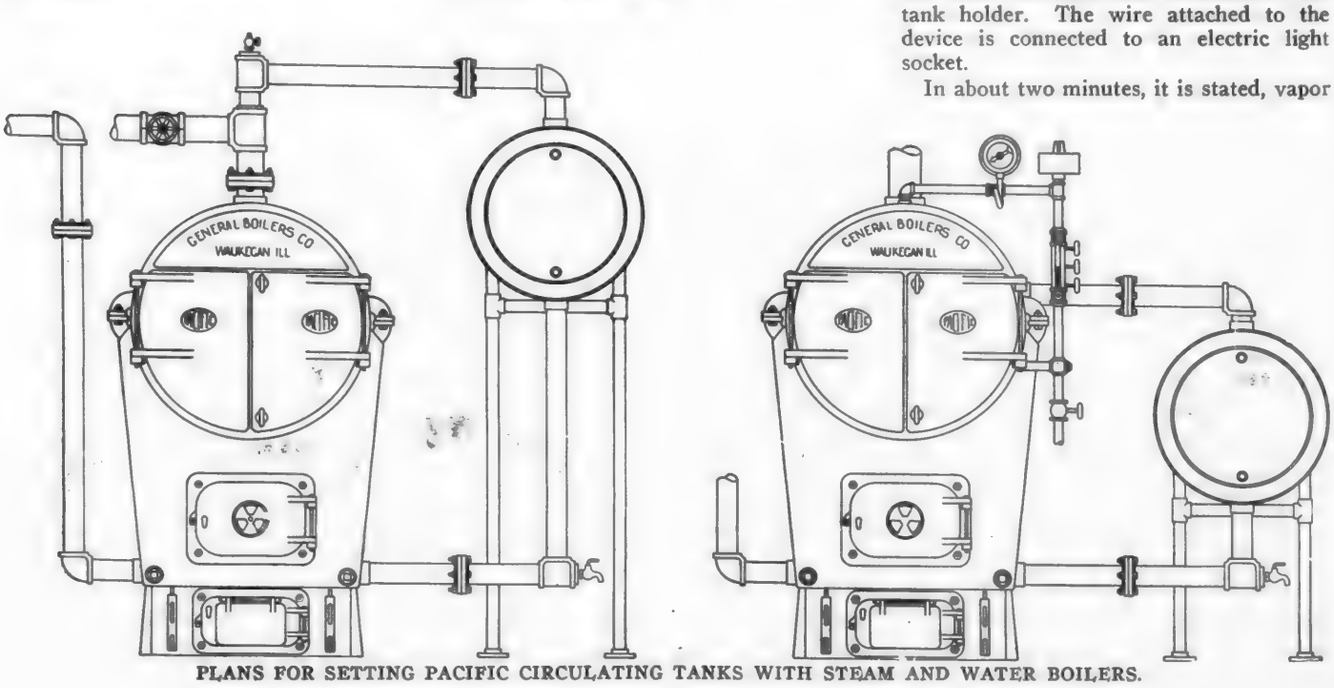
An Electric Air Moistener.

An electric air moistener of unique design has been developed by O. D. Hogue and is shown in the accompanying illustration. A company has recently been organized in Brookline, Mass., taking the name of the Perfect Indoor Climate Company, to market the device which will be known as Hogue's electric air moistener.

This device is for use in connection with steam or water radiators. The evaporating means consists of a cartridge unit in the center of the vaporizing chamber. Water flows down the tank by barometric feed and passes into the vaporizing chamber, literally at about a drop at a time. The electric motor operating the moistener, it is stated, uses only 150 watts at 110 volts A. C. or D. C. per hour. One air moistener, it is added, will humidify to the proper extent, 5000 cu. ft. of enclosed space and also provide for the admission of 2000 cu. ft. of fresh outdoor air per hour.

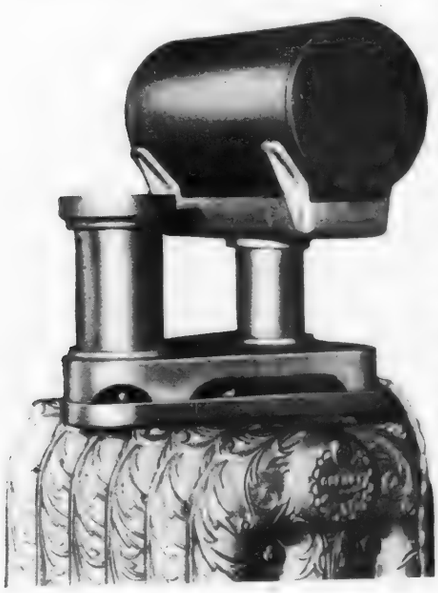
To start the air moistener, the copper water tank is first removed and turned upside down, the funnel fitting the larger tube. Fresh water is then poured into the larger tube until it runs out of the smaller. The tank is then replaced with the tubes down and near the center of the tank holder. The wire attached to the device is connected to an electric light socket.

In about two minutes, it is stated, vapor



PLANS FOR SETTING PACIFIC CIRCULATING TANKS WITH STEAM AND WATER BOILERS.

will begin to rise from the splash cup and will continue to do so until the tank is empty. The total water supply is a little over 1½ gal. A wall radiator is mentioned as particularly adapted to serve as a stand for this air moistener, providing it is not less than 1 in. nor more than 4 in. from the wall. The attachment furnished fits the cast-iron base and has an arm which extends about 6 in. down be-



THE HOGUE ELECTRIC AIR MOISTENER.

hind the radiator. The air moistener weighs 12 lbs. and holds 13 lbs. of water. Its dimensions over all are 12 in. square and 12 in. high.

In discussing the capacity of the air moistener it is stated that the evaporation of ½-pint or 8 oz. of water per hour in 5000 cu. ft. of enclosed space will create and maintain 60% of relative humidity at 60° to 70° F. and permit ordinary ventilation to the extent of 1500 to 2000 cu. ft. of fresh air per house. This, it will be noted, is far below the requirements as reported in tests made in recent years.

TENTH ANNUAL REPORT OF THE SECRETARY OF COMMERCE has been published and contains many items of interest to engineers and business men generally. Perhaps the most important matter dealt with is the reorganization of the foreign trade service. The conferences on housing are discussed, as well as the developments in the coal crisis. The report tells of the scientific assistance in industrial processes and methods, referring especially to the work of the Bureau of Standards and to the organization of committees of manufacturers' representatives in different trades to work with the bureau on various problems of scientific investigation into methods of manufacture and the elimination of waste. The report also discusses the restraint of trade acts, Secretary Hoover's position on this subject being well known. The conclusion is reached that "the working results in our economic fabric in some directions are out of tune with our economic development." Size 6 x 9 in. Pp. 232.

New York's Successful Power Show

Exhibits that filled every available space of the main floor of the Grand Central Palace and an attendance of nearly 48,000 people were the significant features of the National Exposition of Power and Mechanical Engineering which was staged in New York, December 7-13, immediately following the annual meeting of the American Society of Mechanical Engineers. The success of the exhibition was so pronounced that the advisory committee of the A. S. M. E. is already planning to make the show an annual affair. Next year, however, it will probably be held simultaneously with the A. S. M. E. annual meeting.

There was much at the show to interest heating men. Probably the most striking exhibit was that of the Hudson Coal Company in the form of a model of the Loree coal breaker. This directly adjoined a model of a section of an anthracite coal mine. The coal veins at the various levels were clearly shown, even the mine cars and tracks being reproduced in miniature. Among the exhibitors represented, and their products displayed, were the following:

Ashton Valve Co., Cambridge, Mass., gauges, gauge testers, master pilot gauges and pop safety valves.

Bailey Meter Co., Cleveland, O., meters for steam, water, coal, air and gas; also ashpit loss recorders and multi-pointer gauges.

Bishop & Babcock Co., Cleveland, vacuum pumps.

Carling Turbine Blower Co., Worcester, Mass., turbine blowers.

A. W. Cash Co., Decatur, Ill., pressure-reducing and regulating valves and expansion and relief valves.

Celite Products Co., Chicago, Ill., Sil-o-cel insulating brick, block, powder and cements.

D. Connelly Boiler Co., Cleveland, O., Connelly water-tube boilers.

Coppus Engineering & Equipment Co., Worcester, Mass., undergrate blowers, Vano and centrifugal blowers and feed-pump steam turbines; also electric-driven Vano blowers for domestic boilers.

Crane Co., Chicago, Ill., valves, fittings and specialties.

De Laval Steam Turbine Co., Trenton, N. J., auxiliary steam turbines and two-stage centrifugal pumps.

M. H. Detrick Co., Chicago, Ill., flat suspended fire-tile arches and steam jet ash conveyors.

Julian d'Este Co., Boston, Mass., Curtis and d'Este damper regulators and reducing valves; also steam regulators.

Foster Engineering Co., Newark, N. J., automatic valve specialties.

Foxboro Co., Foxboro, Mass., indicating and recording gauges and thermometers; also CO_2 recorders.

Gillis-Geoghegan, Inc., New York, telescopic hoists for ash removal.

Griscom-Russell Co., New York, G-R fuel-oil heaters, Reilly evaporators, G-R instantaneous heaters, multiwhirl oil coolers, multiscreen filters, expansion joints, Stratton steam, oil and air separators, and Bundy oil separators.

H. S. B. W.-Cochrane Corporation, Philadelphia, deaerating heaters and hot process softeners; also multiport back-pressure valves and drainers, flow meters, V-notch meters and weighing meters.

Paul B. Huyette Co., Philadelphia (Jos. W. Hays Corporation) Hays CO_2 and draft recorders, draft gauges and thermometers; also "A-Jacks" damper regulators.

Jenkins Bros., New York, standard valves, rapid-action valves and regrinding marine valves.

Keasbey & Mattison Co., Ambler, Pa., 85% magnesia covering.

Kieley & Mueller, Inc., New York, relief, reducing and back-pressure valves; also Kieley steam traps and damper regulators and governors.

London Steam Turbine Co., Troy, N. Y., governor-controlled turbine for stoker drive.

Midwest Engine & Supply Co., New York, air filters and steel sections for machinery supports.

Nash Engineering Co., South Norwalk, Conn., compressors and pumps. This display was made very striking through the use of an electric sign of the word "Nash."

National Pipe Bending Co., New Haven, Conn., National coil-type feed-water heaters and National U-bend type storage heaters.

Pittsburgh Valve Foundry & Construction Co., Pittsburgh, Pa., standard valves and fittings and motor-operated gate valves.

Republic Flow Meters Co., Chicago, Ill., meters for steam, water air and gas; CO_2 recorders; also Republic system of power plant cost accounting.

Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y., (American Steam Gauge & Valve Co., Boston), indicating and recording gauges and thermometers, tachometers; also pop safety and relief valves.

C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., "Tag" automatic controllers for temperature, pressure, time, etc.; also "Tag-Mono" gas analysis recorders, and indicating and recording thermometers.

Walworth Mfg. Co., Boston, Mass., Watts feed-water damper and pressure regulators, pump governors; also standard valves and Watts regulating valves.

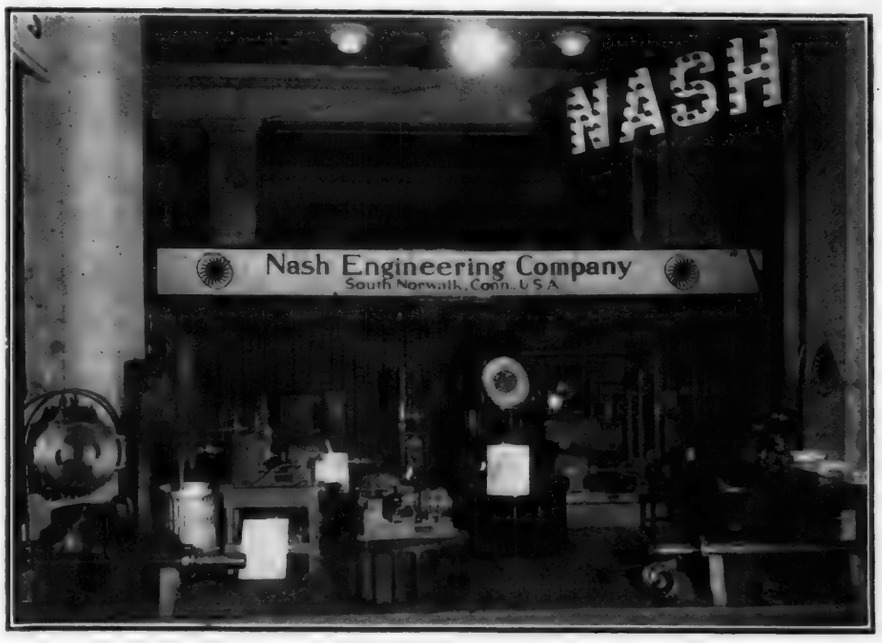
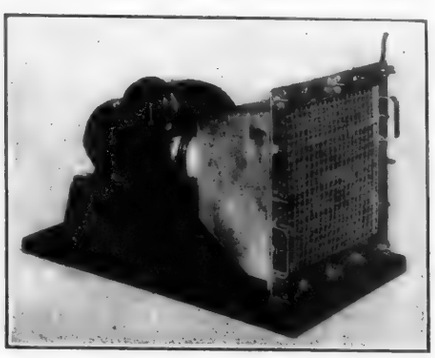


EXHIBIT OF NASH ENGINEERING COMPANY AT NEW YORK'S POWER SHOW.

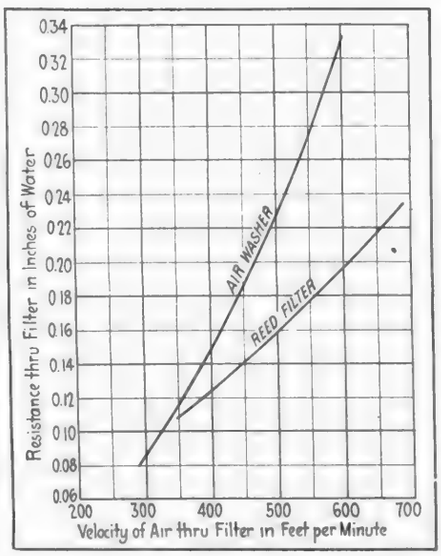
New Trade Publications

MONARCH METAL WEATHER STRIPS are the subject of a carefully prepared bulletin arranged and printed in accordance with the requirements of the Committee on Structural Service of the American Institute of Architects. The manufacturer, The Monarch Metal Products Co., 5020 Penrose, St. Louis, Mo., states that the bulletin embodies all the changes suggested by that committee. It bears the imprint, "AIA Classification File No. 19e14." Following some general notes and a discussion of in-leakage the bulletin presents detail drawings of various applications of the Monarch equipment for double-hung windows, casement windows, and doors. On account of the length of the list of architects to which the company would like to refer, a note is nserted that such references will be supplied direct from the company's files to those making inquiries. The pages following contain a list of the company's licensed representatives. In an appendix of seventeen pages, considerable engineering information is presented, including the paper on "Window Leakage," by Voorhees and Meyer, Jr. (Trans. A. S. H. & V. E.); the chapter on "Air Infiltration," from Webster's "Steam Heating," also the chapter on "Methods of Calculating Heat Requirements," from the same work; some typical calculations made for a residence with and without Monarch metal weather strips; and an extract from the Farmers' Bulletin 1194, of the Department of Agriculture on "Effect of Crack Openings in Window leakage." Size 7½ x 10½ in. Pp. 48.

REED AIR FILTER, the new product of the William Reed Engineering Co., Louisville, Ky., shows some interesting efficiencies, according to a test made recently by the E. Vernon Hill Co., Chicago, and reported in a circular issued by the manufacturers. This is the device which was described in THE HEATING AND VENTILATING MAGAZINE for September, 1922, and advantage is taken of this opportunity to correct a statement in that description to the effect that the filtering material used is absorbent cotton. As a matter of fact, this material is steel wool, coated with the Reed adhesine, which has for its base a non-volatile oil. As the air is drawn through the filter, the oily substances are intended to hold the particles of dust and impurities, leaving only clean, pure air to be delivered to the room. The principle object of the test mentioned was to determine what resistance the standard filter offered to the air flow at normal velocities, and the percentage of dust removal under average working conditions. The test was also made to determine the percentage of air bacteria removed by the filter. The accompanying chart shows the result of the resistance test and another curve is added giving the resistance of a standard-type air washer. A comparison of the two curves shows that at velocities above 330 ft. per minute, the resistance of the air washer increases rapidly above that of the filter. The conclusion is reached that at working velocities the Reed filter as tested has a much lower resistance than the average or even the better grade of air washers. The dust removal and bacteria tests were equally satisfactory, reaching, in one case, to over 99 per cent. and, in the other, to 98 per cent.



THE REED AIR FILTER.



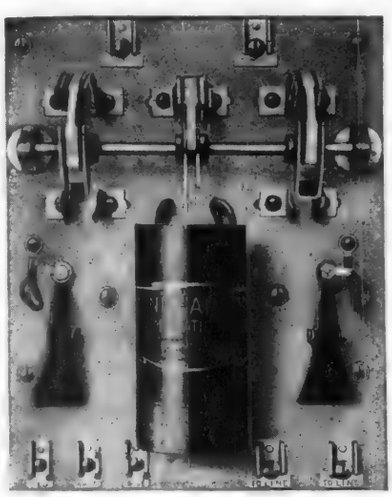
RESULT OF AIR RESISTANCE TEST WITH REED FILTER.

FOXBORO RECORDING THERMOMETERS are brought to the attention of the trade in a novel circular published by the Foxboro Co., Foxboro Mass. The circular itself is trimmed to show the outline of the recording thermometer itself with a large illustration of the dial. On turning over the page an illustration of the same size shows the interior mechanism. Special attention is called in the accompanying text to the inverted-pen-arm movement which is designed to prevent the ink from running down the pen-arm. This instrument also has a long-distance measurement feature, making it possible to place the bulb 500 ft. from the recording case and secure accurate records. No mercury is used in the instrument; it is actuated by the vapor pressure of a volatile liquid or the direct expansion of a gas. Bulbs having ranges of from—60° to 1,000° F. are furnished. Size 9½ x 12 in. Pp. 4.

STURTEVANT GENERATOR COOLING APPARATUS is covered in a recent catalogue (No. 246) issued by the B. F. Sturtevant Co., Hyde Park, Boston, Mass. In addition to views of a number of important installations, the catalogue discusses three typical arrangements of air cleaning and cooling apparatus for this service, together with a closed air system. In each case, the Sturtevant type H air washer is used. Size, 8½ x 11 in. Pp. 28. Another bulletin (No. 288) contains a paper by H. F. Hagen, research engineer for the company, read before the Stoker Manufacturers' Association in Shawnee, Pa., on "Forced and Induced Draft with Mechanical Stokers."

TIN-O-RED, described as the chemically-pure imported oxide paint, is featured in a letter-circular, showing its use on rainproof materials on which, it is stated, it sets quickly, dries in 6 or 8 hours, brushes freely, has unusual covering capacity and will not run or drip from gutters or spouting. It is made by the Ferbert-Schorndorfer Co., Cleveland, O.

MINNEAPOLIS THERMOSTATIC RELAY SWITCH, described as a new type of switch for the thermostatic control of motors, electric heating units and other electrical units, has been brought out by the Minneapolis Heat Regulator Co., Minneapolis, Minn., and is described in one of the company's new circulars. This device was developed particularly automatically controlling oil-burning and refrigerating devices, but has been found to have a wide range of usefulness, not only for the starting and stopping of motors according to temperature changes, but also for remote control work. The unit is capable of handling A. C. current at 110 volts and is designed for a maximum capacity of 20 amperes. The relay, it is stated, is operated on an entirely new and novel principle. The unit is in reality a double-control switch providing a low-voltage circuit to the thermostat operated at 7½ volts at less than 15 watts. The power for this low voltage circuit is provided from a transformer built integrally into the relay. The thermostat



NEW THERMOSTATIC RELAY SWITCH.

or temperature changes selectively energize two low-voltage magnets which in turn energize 110-volt solenoids closing or opening the main line circuit to the motor or other apparatus to be controlled. In this way, it added, there is combined all the advantages of a 110-volt circuit closing switch with the advantages of a low-voltage switch for the thermostatic circuits. Size 8½ x 11 in. Pp. 4.

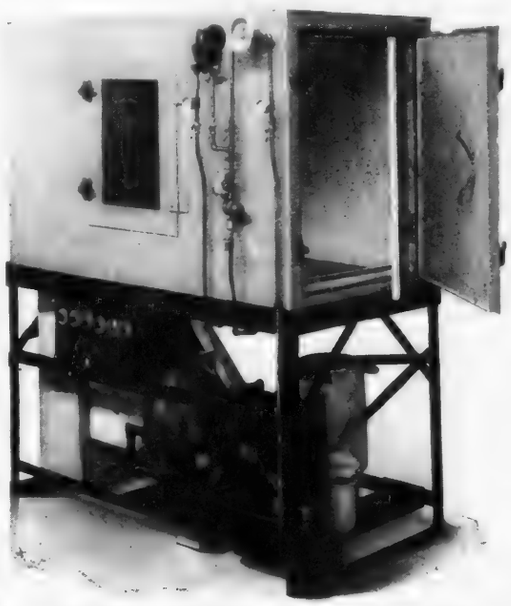
PAGE VOLUNTEER AND MONARCH BOILERS, for steam and water heating, are covered in a new catalogue issued by the Wm. H. Page Boiler Co., 141-145 West 36th St., New York. In the company's "announcement" at the beginning of the catalogue, attention is called to the fact that the company commenced the manufacture of steam and water heating apparatus over half a century ago and that it is today the largest maker of boilers exclusively, in the world. Each type is then taken up in detail, beginning with the Monarch line, including the Monarch up-draft smokeless boiler and the Monarch down-draft smokeless boiler. Another section is devoted to the Volunteer line which are of the round type. The third section of the catalogue is devoted to Volunteer hot water supply boilers and various heating specialties, concluding with a section of some 20 pages of data. Size 4½ x 7½ in. Pp. 120.

ENGINEERING ACHIEVEMENTS OF THE WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., for the year 1922, are the subject of a noteworthy circular prepared by H. W. Cope, the company's assistant director of engineering. The contributions of the Westinghouse company toward the progress of the art, as listed, form an impressive exhibit. Size 8½ x 11 in. Pp. 8

UTICA-IMPERIAL SUPER-SMOKELESS BOILERS for industrial buildings, offices and garages, are the subject of the sixth bulletin in the series recently issued by the Utica Heater Co., Utica, N. Y. The next bulletin, which will complete the series, will be largely technical. In the present bulletin numerous photographic reproductions are presented of buildings in which these boilers are installed, such as the Pittsburgh Taxicab Company's Garage, in Pittsburgh, the Brotherhood of R. R. Trainmen in Cleveland, the Reliance Building in Chicago, and the Professional Building in Washington. The center pages are devoted, as in the other bulletins, to a sectional view, in colors, of the construction and operation of the Utica-Imperial Super-Smokeless boilers. Size 8½ x 11 in. Pp. 16.

PACIFIC STEEL HEATING BOILERS, smokeless and direct-draft types, are brought to the attention of the trade in a well-compiled bulletin (No. SC22) which gives full data, with descriptive text and illustrations, of the Pacific firebox smokeless boilers, Pacific firebox direct-draft boilers and Pacific down-draft boilers, manufactured by the General Boilers Co., Waukegan, Ill. Special emphasis is laid on the fact that Pacific boilers, which have been on the market since 1914, are built for steam or hot water in both the smokeless and direct-draft types, for every kind of fuel. The firebox is a water leg, the full length and width of the shell, providing a wall entirely around the furnace. The lower half of the shell lies directly over the fuel bed. This and the vertical wall of water in the firebox are thus in a position to absorb the radiant heat from the fuel and burning gases. Attention is also called to the fact that every seam and joint in the shell and firebox of these boilers is electrically welded, including staybolts and braces. They are described as requiring considerably less than the usual amount of floor space for a given capacity. Size 8¾ x 11¼ in. Pp. 12.

CARRIER EJECTOR PROCESSING CABINET for industrial and scientific laboratories is described with numerous illustrations, in a new circular issued by the Carrier Engineering Corporation, Newark, N. J. The accompanying descriptive text goes fully into the construction and uses of the cabinet which include the determination of the effects of air upon hygroscopic materials, and the process of drying of such materials under automatically-controlled conditions of temperature, humidity and air velocity. In addition to the standard units, the company, it is stated, is also prepared to furnish "government size" cabinets which are twice the standard size and capacity.

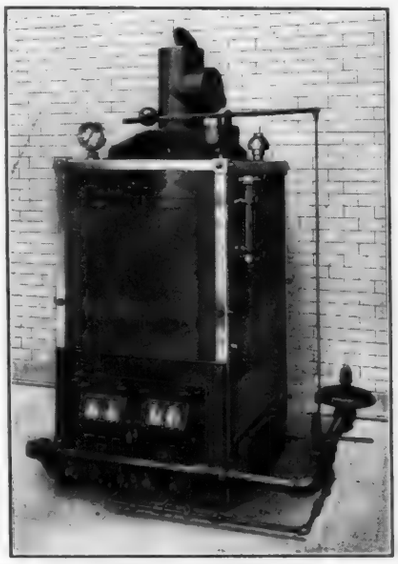


CARRIER EJECTOR PROCESSING CABINET, STANDARD SIZE.

Both types are equipped with dehumidifying attachments. Size 4 x 9 in. Pp. 32

VALVE WORLD for December, 1922, the monthly periodical of Crane Co., Chicago, Ill., has a feature article on "Modern Piping in Minnesota Mills," which is accompanied with views of boiler-room and engine-room piping in the plants of the Northwest Paper Co., at Cloquet, Minn., and the plant of the Capital Elevator Co., in Duluth.

WEATHER VEIN for January, 1923, the periodical of the Carrier Engineering Corporation, Newark, N. J., carries the name of the Carrier Engineering Co., Ltd., of 24, Buckingham Gate, London, England, which was organized by J. I. Lyle, treasurer and general manager of the company, while abroad last summer. The January number is devoted to the sheet metal service offered by the Carrier Construction Company, the illustrations including views of the company's sheet metal shop. The announcement is made that The Weather Vein will appear hereafter every other month.



IDEAL GAS BOILER.

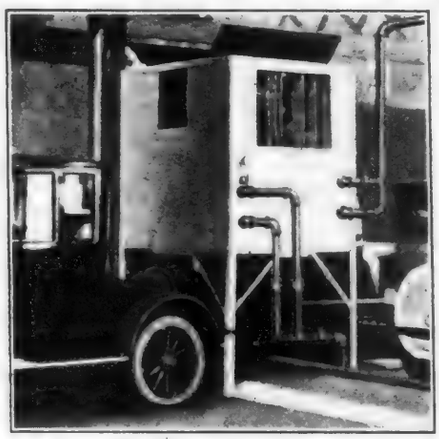
IDEAL GAS BOILER, which formed one of the interesting exhibits at the American Gas Association convention, in Atlantic City recently, is described in detail in a catalogue issued by the American Radiator Co., Buffalo, N. Y. The accompanying illustrations give a very clear idea of its appearance and construction. This heater is, of course, not offered as an economy proposition, but frankly as one for the householder who can afford the additional comfort and convenience of such an apparatus. In the metropolitan district it is figured that the fuel cost will run up to perhaps three or four times the cost of coal at prevailing prices. Tests conducted at the company's Institute of Thermal Research in Buffalo show that this heater is capable of utilizing 90% of the heat available in the gas. Uniform temperature is obtained through the use of an Arco temperature regulator arranged to be automatically controlled from the

TYPICAL SECTION AND BURNER OF IDEAL GAS BOILER.

rooms above. An important point noted in connection with the use of these heaters is that they make it possible to add another room to the house by having the cellar free of coal or ash dust. Size 6 x 8 in. Pp. 12.

The Twinfan Unit System.

Another portable fan-blast heater for industrial buildings, to be added to the group recently described in these columns, is the Twinfan, manufactured by the Dwyer Equipment Co., 4534 West North Ave., Chicago, Ill. As will be seen from the accompanying illustrations, each unit, when connected up, forms a complete heating machine. The unit is built of structural steel, with sheet-metal casing. Radiators designed for this type of work are located in the bottom of the unit.



TYPICAL INSTALLATION OF TWINFAN UNIT SYSTEM.

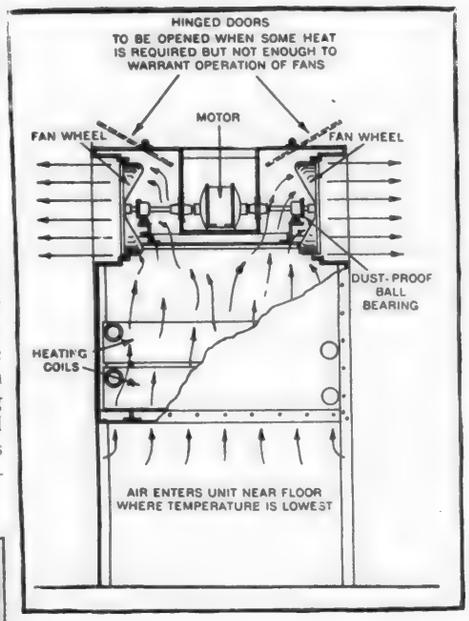
An electric motor driving two fans is placed above the radiators. Steam is supplied to the heating coils in the usual way. The fans draw cold air from the floor over the radiators and blow the heated air out from the unit.

Because of the rapid movement of air over the radiators in the Twinfan unit, they are capable of delivering, it is stated, about five times as much heat as the corresponding amount of radiation placed in the room in the ordinary way. Emphasis is also laid on the point that the space occupied by the Twinfan unit is small as compared with the space occupied by radiators of the same capacity.

It will be seen from the illustration that the motor is not in the path of the heated air and that the cold air is drawn in from near the floor line. The large intake area, together with the hinged doors, make it possible to operate the equipment in moderate weather without running the fans.

The Twinfan system uses electric power only for circulating the air. Stopping the fans, it is pointed out, immediately cuts off from two-thirds to three-fourths of the heat output which is sometimes a very desirable thing to do as compared with the alternative so often adopted of opening windows.

These units, it is added, operate on any system of steam circulation, gravity, vacuum or vapor. Finally, the point is made that the Twinfan system may be used in summer to keep the air in the

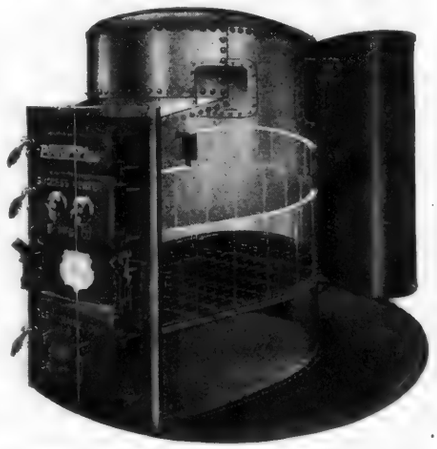


COURSE OF AIR THROUGH TWINFAN UNIT HEATER.

building in circulation. This is considered an especially desirable feature on hot muggy days and as a general practice in garages where a number of cars may have their engines running.

The Power-Plus Warm-Air Generator.

An unusual type of warm-air furnace has been recently designed by the Success Heater & Mfg. Co., Des Moines, Ia., and is being marketed under the name of the Power-Plus warm-air generator. The body of this powerful heating unit is practically one piece, built of heavy-weight rust-resisting iron, with seams riveted and caulked to make them gas and smoke-tight. The heavy rocker grates provide over



POWER-PLUS WARM-AIR GENERATOR.

7¼ sq. ft. of grate area. The construction of the heater itself gives it no less than 100 sq. ft. of prime heating surface. The heater is especially adapted for use in large residences, auditoriums, schools and churches.

New Publications

SCIENCE OF SELLING, by Gordon J. A. Hargrave, of the Hargrave Service Systems, 25-29 West 43rd St., New York, is the title of a circular devoted to the methods which have been developed by Mr. Hargrave in his work as sales counselor. Special interest attaches to this service through the fact that Frank T. Chapman, of New York, a well-known figure in the heating and ventilating industry, has recently joined the Hargrave Service Systems as general manager. The circular contains the titles and synopses of some 50 talks on such subjects as "The Only Way to Be a 'Master Salesman,'" "The Buyer Who Wants Many General Ideas," "How to Tell When the Prospect is Negative," "The Real Reason for the Leader and the Tail Ender," "The Way You Talk," "How to Develop Determination," concluding with "The Master Salesman." "Know how to be a leader—a master," urges the author, "follow the rules that are as sure and fundamental as the laws of gravitation and you will reach your goal."

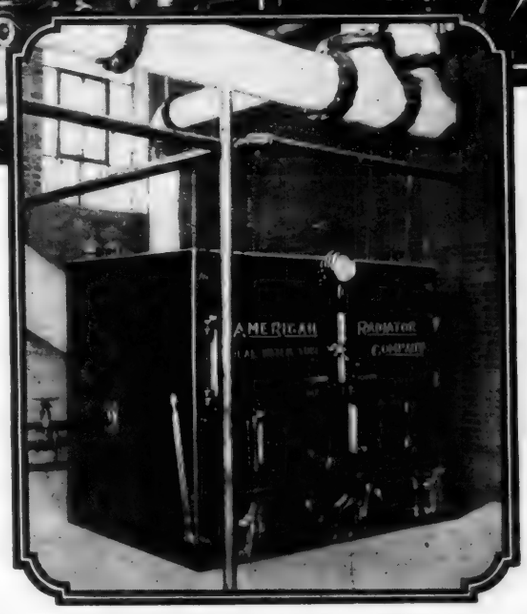
BULLETIN OF THE NATIONAL DISTRICT HEATING ASSOCIATION for October 15, 1922, contains, among other things, a tentative program of the next annual convention of the association in Cedar Point, O., June 20-23, 1923. Heating rates for 1922-1923 of some 122 companies are contained in this issue, taking up some 40 pages.

New Books

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES, for 1923, has been issued by S. E. Hendricks Co., Inc., 70 Fifth Avenue, New York. It is a volume of 2482 pages, 8½ in. x 11½ in. and sells for $15.00. The new edition contains over 150 pages more than the 1922 edition and embraces some 125,000 changes and additions. As is well-known, the lists cover the electrical, engineering, machinery, building, manufacturing and other industries. In addition, over 18,000 products are separately classified. Those familiar with this reference book do not need to be told of its comprehensiveness and usefulness. May be had direct from the publishers or through the book department of THE HEATING AND VENTILATING MAGAZINE.

HOME INSTRUCTION FOR SHEET METAL WORKERS, by William Neubecker, is the title of a practical manual for the apprentice, mechanic and master sheet metal worker, covering the course of instruction in the sheet metal department of the New York Trade School. Detail instructions are included on cutting, forming, soldering, preparing full-size details from architects' blueprints, developing the patterns, laying out the work on sheet metal, forming and bending on the brake and setting the work together. Supplementing the book are 15 folding plates bound separately. Size 6 x 9 in. Pp. 400, with 684 ills. Bound in cloth, $5.00 postpaid. Published by the U. P. C. Book Co., Inc., New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

The Glenville Hospital, Cleveland, O., where again has been proved that a low pressure, sectional boiler can furnish better warmth for less. This T-79-10 IDEAL Water Tube Boiler is connected with 8300 feet of radiation. Architect, Harlen E. Shimmin; Heating Engineers, Phegley & Szekely; Heating Contractors, Becker Heating & Ventilating Co.



For large buildings— low pressure boilers

IF THE HEATING PLANT for home, office or factory is important, for a hospital it is vital.

The officials of the Glenville Hospital, Cleveland, Ohio, realized this when, in 1921, they replaced their old worn-out heating plant with this IDEAL 79" Water Tube sectional boiler.

Connected with 8300 feet of American Peerless Column and Wall Radiation, this single low pressure, heavy duty boiler warms every room of the original building and the new addition. A small tubular boiler supplies the sterilizing apparatus, steam tables and laundry with high pressure steam.

That the new plant is a great success is shown by the following statement received from the superintendent after the plant had been thoroughly tested:—

"We find the boiler is satisfactory in every respect. Our Engineer seems to take a new pleasure in his work. We feel indebted to you."

There are so many interesting points of construction about the IDEAL 79" Water Tube Boiler that a booklet is necessary to present them fully. Your name on your letterhead sent to either address below will bring it.

AMERICAN RADIATOR COMPANY

IDEAL Boilers and AMERICAN Radiators for every heating need

104 West 42nd Street, Dept. T-7
NEW YORK

AMERICAN RADIATORS | IDEAL BOILERS

816 So. Michigan Ave., Dept T-7
CHICAGO

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating-Steam-Roof

Radiation to Compensate for Heat losses through Various Roofs. temp. dif 70°

Area in Sq. Ft.	Direct steam Radiation						
	A	B	C	D	E-E1	F-F1	G
60	7	8	12	11	16	6	24
80	9	10	16	14	21	8	34
100	12	13	20	18	26	10	43
120	14	16	23	21	31	12	51
140	17	18	27	25	36	14	60
160	19	21	31	28	42	16	69
180	21	23	35	32	47	18	77
200	24	26	39	35	52	20	86
220	26	29	43	39	57	22	95
240	29	31	47	42	63	24	103
260	31	34	51	46	69	26	112
280	33	36	55	49	74	28	120

A = 6" Hollow tile - 2" Concrete with tar & Gravel.
B = 8" do do do
C = 4" Concrete with cinder fill.
D = 6" do do
E1 = Tile 3/8 to 1" thick
E = Slate on wood framing only
F = Patent roof (Tar, Gravel, paper etc)
F1 = Slate on tight wood sheathing
G = Iron on wood framing only

RADIATION COMPUTING—Steam Heating, Roof. No. 13-GG

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating-Hot Water-Roof.

Radiation to Compensate for Heat Losses through Various Roofs temp. dif. 70°

Area in Sq. Ft.	Direct Hot Water Radiator						
	A	B	C	D	E-E1	F-F1	G
60	12	13	20	17	26	10	43
80	16	17	26	23	35	13	57
100	20	22	32	29	43	16	71
120	23	26	39	35	52	20	86
140	27	30	46	41	60	22	100
160	31	35	52	47	69	26	114
180	35	39	58	53	77	29	129
200	39	43	64	59	86	32	143
220	43	47	71	65	95	35	156
240	47	52	72	71	103	38	170
260	51	55	84	76	112	42	185
280	55	59	90	82	121	45	199

A = 6" Hollow tile - 2" Concrete with tar & Gravel

B = 8" do do do

C = 4" Concrete with cinder fill

D = 6" do do

E1 = Tile 3/8" to 1" Thick

E = Slate on wood framing only

F = Patent roof (Tar, Gravel, paper etc)

F1 = Slate on tight wood sheathing

G = Iron on wood framing only

RADIATION COMPUTING—Water Heating, Roof. | No. 13-HH

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating-Steam-Ceilings

Radiation to compensate for Heat Losses through various Ceilings Temp dif 40°

Area in Sq. Ft	Direct Steam Radiation						
	A	B	C	D	E	F	G
60	5	3	3	5	2	4	1
80	6	3	4	6	2	5	1
100	8	4	5	8	2	6	2
120	10	5	6	9	3	8	2
140	11	6	7	11	3	9	2
160	13	7	8	13	4	10	3
180	14	8	9	14	4	12	3
200	16	9	10	16	5	13	3
220	18	10	11	18	5	14	3
240	19	11	12	19	6	15	4
260	21	12	13	21	6	17	5
280	22	13	14	22	7	18	5

A: Top floor ceilings of residences - Plaster, air space, sheathing, paper, shingles. Temp. dif. = 70°, 25% Exposure.

B: Lath and plaster, single floor above

C: do do No floor above

D: Fire proof. Metal lath no floor above

E: do do Floor above

F: Cement or tile no floor above

G: do do Floor above

RADIATION COMPUTING—Steam Heating, Ceilings. | No. 13-II

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating · Hot Water · Ceilings

Radiation to compensate for Heat Losses through Ceilings temp. dif. 40°.

Area in Sq. Ft.	Direct Hot Water Radiation						
	A	B	C	D.	E.	F.	G.
60	8	4	5	8	2	6	2
80	11	6	7	11	3	8	2
100	14	7	9	13	4	10	3
120	16	8	10	16	5	12	3
140	19	10	12	18	6	14	4
160	22	11	14	20	6	16	5
180	24	12	15	24	7	18	5
200	27	14	17	26	8	20	6
220	30	15	19	29	9	22	6
240	32	17	21	31	10	24	7
260	35	18	22	34	10	26	8
280	38	19	24	37	12	28	8

A · Top floor ceilings of residences · Plaster, air space, sheathing, paper, shingles. Temp dif · 70° 25% Exposure

B · Lath and plaster, single floor above

C · do do No floor above

D · Fire proof. Metal lath, No floor above

E · do do Floor above

F · Cement or tile No Floor above

G · do do Floor above

RADIATION COMPUTING—Water Heating, Ceilings. | No. 13-JJ

Copies of this Data Sheet, printed separately, 5 cents each.

EFFICIENT HEATING
demands the JENNINGS PUMP

DUPLEX "D" UNIT
CONTINUOUS
OPERATION

Hill Street Theater,
(Junior Orpheum Circuit)
Eighth and Hill Streets,
Los Angeles, Calif.

Capacity each pump 40,000 sq. ft. direct radiation, air capacity 25 cubic feet per minute in addition to a water capacity of 60 gallons per minute. The Motors are only 3 Horse Power.

THE Jennings Pump consists of two independent turbine units, an air pump and a water pump. As each material is handled separately, the boiler pressure is against the water only. The air and vapor approximately four-fifths of the volume handled, are delivered to atmosphere without back pressure. The saving in horse power is over fifty per cent. In other words, the cost of current to operate is cut in half.

Because of its compact design, this equipment can be installed in less than one-third the space necessary with other apparatus. All interior parts are bronze, supported on annular ball bearings mounted outside of casing. Moving parts revolve without contact.

Quiet, reliable operation without annoyance because of shut downs, and minimum of expense for repairs, is assured if the Jennings Hytor Vacuum Heating Pump is installed on your Vacuum Heating System.

There are many other reasons why the Jennings is being installed on practically all of the big jobs. Bulletin No. 15 gives them in detail. Write for it.

THE NASH ENGINEERING CO.
Plant and General Offices
SOUTH NORWALK, CONN.
SALES OFFICES
BOSTON—185 Devonshire Street
BUFFALO—1044 Ellicott Square
CHICAGO—1220 Monadnock Block
CLEVELAND—326 Frankfort Ave. N. W.
DALLAS—Dallas Bank Building
DENVER—Boston Building
DETROIT—Kerr Building
HOUSTON—Southern Pacific Building
INDIANAPOLIS—Hume-Mansur Bldg.
KANSAS CITY—Mutual Building
LOS ANGELES—218 East Third Street
MINNEAPOLIS—501 S. Sixth Street
MONTREAL—84 Inspector Street
NEW ORLEANS—521 Baronne Street
NEW YORK—350 Madison Ave.
PHILADELPHIA—Stock Exchange Bldg.
PORTLAND—224 Pine Street
PITTSBURGH—Oliver Building
SALT LAKE CITY—Dooley Building
SAN FRANCISCO—Sharon Building
SEATTLE—220 Railway Exchange
ST. LOUIS—Chemical Building
TOLEDO—1-9 St. Clair Building
TORONTO—Kent Building
WASHINGTON—710 14th Street, N. W.

The NASH ENGINEERING COMPANY
SOUTH NORWALK, CONN., U. S. A.

Trade and Miscellaneous Notes

Coming Events.

January 23-26, 1923.—Annual meeting of the American Society of Heating and Ventilating Engineers, in Washington, D. C. Headquarters at the Washington Hotel.

Jan. 30-Feb. 2, 1923.—Fourth annual meeting of the Associated General Contractors of America, in Los Angeles, Cal. The meeting will be devoted largely to the consideration of progress in the work on standard contract forms and construction equipment.

Miscellaneous Notes.

Associated General Contractors calls attention to the fact that construction is one of the great essential industries to be taken into account in all industrial and economic actions, and not a non-essential as heretofore considered. This, it is stated, is the result of the recent appearance of the A. G. C. before the Interstate Commerce Commission and its continuing appearance before that body and the American Railway Association on behalf of its members. The association has been especially active in securing additional cars for carrying construction materials, despite the embargoes.

Elimination of Waste in Government Engineering was the subject of an address by John T. Pratt, chairman of the National Budget Committee, at a joint meeting of the New York section of the four principal engineering societies, in New York, December 13.

Chamber of Commerce of the United States, through its Fabricated Production Department, announces that in 25 forms presented as a treatise on budgeting as a means of business control, one of the forms shows a novel clock arrangement by which the small manufacturer can tell at a glance the daily state of his business. Clocks, or dials, are devised for each of the principal activities of the business. Each clock has two hands, a red one pointing at the budget allowance, which remains stationary for the entire month, and a black hand which is set daily at the amount of money spent by each department.

National Tube Co., Pittsburgh, Pa., has announced the establishment of an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, Pittsburgh, Pa. This industrial fellowship is engaged in a systematic study of practical methods for the prevention of corrosion in hot-water supply systems. It is also giving attention to the classification of waters of various chemical composition, with respect to their relative corrosive action upon iron and steel, particularly in the form of pipe lines, boiler-economizers, tubes, etc. The present incumbent of the industrial fellowship is Clifford R. Texter, who for the past several years has been carrying out research on the corrosion of iron and steel, where not exposed directly to the atmosphere. Mr. Texter will be glad to correspond with engineers and manufacturers interested in the field to which his industrial fellowship relates.

Department of Commerce reports that figures received in connection with its monthly "Survey of Current Business," indicate even greater industrial activity in October than was at first reported. The output of almost all basic commodities showed large increases, sometimes even in the face of the seasonal decline. The petroleum industry established several new records in October, the production of 47,255,000 barrels of crude oil being the largest ever reported for one month. Consumption jumped to 52,269,000 barrels, compared with the previous maximum of 50,141,000 barrels, reported for August, 1922. Stocks again increased to a new high level of 274,438,000 barrels.

42-inch Autovent Propeller Fan Installed Within Lounging Room, Hoosier Square and Compass Club, Indianapolis, Ind.

REGISTERED AUTOVENT TRADE MARK

This is a concrete example of the practical and efficient application of an

AUTOVENT FAN

Write us about any ventilation or air conditioning problem. Our engineers will be glad to help you. There is no need for guesswork. Data is given without obligation to you.

AUTOVENT FAN & BLOWER CO.

730-736 W. Monroe Street, Chicago, Ill.

Associated Building Contractors of Illinois are planning a school for foremen as a preliminary step toward a big apprenticeship training program. It is proposed to give instruction in methods of efficiency, cost keeping, managing of men; in the qualifications necessary to a foreman; and in principles of social psychology. The first course, which has been prepared by a committee headed by Gerhardt F. Meyne, will begin in January, and contractors are asked to send one or more of their foremen for the short course.

November Construction is 30% ahead of last year, according to the F. W. Dodge Company's review of building activity during November, 1922. Building contracts awarded in the 27 northeastern States during that month amounted to $248,366,000, which is only 2% under the October figures and 30% over those for November, 1921. Residential construction was 51% of the total; business buildings, 12%; industrial buildings, 12%; and public works and utilities, 11%; miscellaneous, 14%. Construction work started during the first eleven months of the year amounted to $3,135,812,000. This is 45% greater than the total for the corresponding period of last year, and 33% greater than the total for 1921. In New England the building contracts in November amounted to $26,770,000, an increase of 2% over October and 45% above November, 1921. In New York State and northern New Jersey, the contracts amounted to $76,571,000, an increase of 18% over the previous month, and 30% over November, 1921. The Middle Atlantic States reported figures of $32,983,000, an increase of 5% over October and 9% over November, 1921. A fair showing was made in the Pittsburgh district, the total being $41,691,000, a decrease of 24% from October, but an increase of 26% over the corresponding month of last year. In the Central West the contracts amounted to $66,395,000, a decrease of 9% from October, but an increase of 46% over November, 1921. The Northwest reported figures of $3,948,000, an increase of 36% over the previous month and a decline of 16% from November 1921.

Washington, D. C.—Remarkable, nation-wide interest in foreign markets, reflected by a 400% increase in inquiries directed to the Department of Commerce by American Business establishments of all kinds, during 1922 over 1921, is disclosed in the annual report of Director Julius Klein of the Bureau of Foreign and Domestic Commerce.

The Air You Breathe Should be As Pure as the Water You Drink

Wherever you live, shop, work or dine, attend church or theatre, you are wisely cautioned to look for good ventilation as you would for a fire escape

HIGH TRADE EFFICIENCY ILG MARK VENTILATING MACHINERY

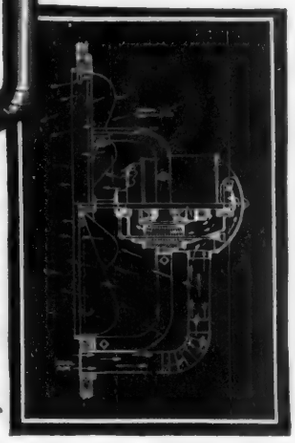
In the office ILG Ventilation promotes health and efficiency.

Shopping is a pleasure in the store that has ILG Ventilation.

An ILG Fan in the restaurant banishes cooking odors and oppressing heat.

ILG Ventilation in public garages is a safety-first measure.

Self Cooled Motor Fans are safeguarding your health in thousands of stores, offices, halls, theatres, restaurants, etc., everywhere.



A sectional view of the *Ilg Self-Cooled Motor Propeller Fan,* illustrating the patented method of ventilating the motor by the vacuum created at the axis of the fan, drawing a current of air from the outside through the tube or vent pipe connecting with the hood which completely encloses the motor on all sides but the front. The vent pipe serves as an intake for the air, guides it to the heart of the motor where it is carried away with the general exhaust. This all-important feature is broadly protected by basic patents.

ILG Ventilation is a guardian of human welfare in public buildings.

Foul air does not contaminate food products where there is ILG Ventilation.

ILG Ventilation promotes good health sanitation and personal hygiene.

Industrial plants recognize ILG Ventilation as the life force of man-power.

Send for Literature

ILG ELECTRIC VENTILATING CO., 2858 N. Crawford Ave., Chicago

BRANCHES IN ALL PRINCIPAL CITIES

You

are safe if you insist on

Carrier Air Washers

without fear of complaint. Most of the representative buildings today use these Air Washers.

They are fool proof and very simple, so stay in operating condition.

They are effective, removing from the air 90% of the germs and pailfuls of filth each week.

They require little attention. Flushing to sewer and cleaning once a week is sufficient.

Without obligating you our Engineers will bring a wealth of information gained during two score years' leadership, to help solve your problems.

Write us today to Dept. No. 36.

Carrier Air Conditioning Company of America

480 Broadway, Buffalo, N. Y., U. S. A.

Industrial Activity is near the 1919 peak level, according to the bi-monthly review of industrial-economic conditions in the United States recently issued by the National Industrial Conference Board, New York. The recovery of business in the United States since the severe depression late in 1920 and early in 1921, states the report, has been unusually rapid, and industrial activity today is fast approaching the level at the peak of the boom of 1919-1920. General business, it is added, is probably not quite up to this point. The most serious impediment to increasing business and to further industrial activity, it is pointed out, is the car shortage, which has prevented those industries which ship in carload lots from attaining as large an output as would otherwise be possible. This condition is described as partly an echo of the railway shopmen's strike during the summer, but is more definitely a result of the tremendous volume of industrial and agricultural products which the railroads have been called upon to transport. The housing shortage, in spite of the record-breaking construction activities, has by no means been met, so that a continued activity in the building industry is expected.

C. E. Pearce is now engineer in charge of mechanical equipment of buildings for Guilbert & Batelle, Newark, N. J. Mr. Pearce was previously manager of the heating department of the Richard D. Kimball Co., New York.

Hampton Institute, Hampton, Va., will hold its first annual builders' conference, January 29, 30 and 31, 1923. This conference is designed to give colored builders an opportunity to keep abreast of developments in the field of building, to see demonstrations of new materials, methods and machinery, and to receive instruction from experts. The program has been arranged by H. Whittemore Brown, who is in charge of the newly-organized Department of Building Construction at Hampton Institute.

Wholesale prices of building materials have been steadily on the increase since February, according to statistics reported by the Bureau of Labor Statistics of the Department of Labor and plotted in chart form by Dwight P. Robinson & Co., Inc., New York. Five curves are plotted, giving figures for lumber, common brick, structural steel, other building materials and, finally, the average of all building materials. These are plotted with the average for 1913 as the base. It is noticeable that the increase was considerably accelerated during August and September of 1922, due doubtless in large measure to railroad difficulties, aggravated by the coal shortage. There is no development, it is added, which would indicate a reversal of the upward trend, although it is probable that the rate of increase will be less as the temporary conditions due to coal and railroad difficulties are corrected.

Cleveland, O.—"Better Homes Exposition" being a continuation of the American Building Exposition, will be held again this year in Cleveland, the dates being April 4 to 14. In an announcement calling attention to the exposition, the year's construction figures in Cleveland are cited, the total being more than $22,000,000 over the corresponding period of 1921, and this showing is attributed to the American Building Exposition. The forthcoming exposition, while retaining all the features of the building show, will in reality have in combination as well, both a home-furnishing and an electrical show. To this end the Cleveland Retail Furniture Dealers' Association and the Electrical League of Cleveland have joined forces for its promotion. The exposition will be under the same management as the building show. Ralph B. Stoddard will be managing director, and Richard G. Collier, manager. Both floors of the Cleveland Auditorium will be used. Offices have been opened in the Schofield Building and space sales have already begun.

New York.—The next annual Own-Your-Home Exposition in New York will be held April 21-28. Milton Dana Morrill is chairman of the publicity committee.

Reuben N. Trane, president of the Trane Co., La Crosse, Wis., has returned from a trip to England and France.

The "Camelback" Air Diffuser

is a device which architects and engineers have found that by its use the desired volume of fresh air is introduced and distributed throughout the auditorium at a minimum of cost and friction loss.

BECAUSE

1. Less duct work is required, saving a great expense in masonry.
2. Its construction of two way air delivery at ends, permits the discharge of the maximum quantity of air with the minimum number of diffusers.
3. Its angular shape makes it uncomfortable as a foot rest.
4. Friction loss is negligible.
5. It admits of the use of the lowest slung chair seat.
6. It is made of heavy cast iron with wire screen over ends and is guaranteed to last.
7. It has two controlling dampers, regulated independently of each other and is furnished without dampers if desired.

Every Architect and Engineer owes it to his clients to be well informed on latest ventilating practices. For that reason you should be familiar with the "Camelback." Send for Blueprints.

Knowles Mushroom Ventilating Co.
202 Franklin St. New York City
Manufacturers of Knowles Aisle-Hood, and Mushroom Notch

JAMES M. SEYMOUR
Established 1888
Lawrence St., Mechanic St. and Kirk Place
NEWARK NEW JERSEY

PROPELLER TYPE FANS

Many styles for many kinds of service. Low pressure Fans that deliver immense volumes of air at low velocity.

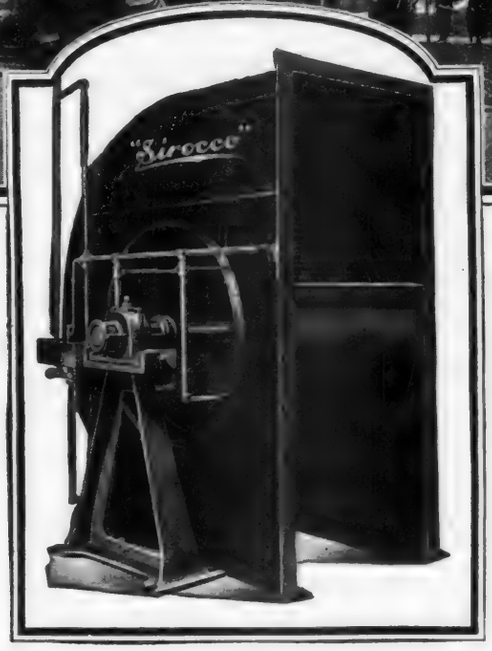
Cone cased Fans for higher pressures, Extreme Fans for high pressure and high velocity.

Compound Fans from 11 feet in diameter to 24 feet in diameter for Mine Ventilation.

Hyatt Roller Bearings. Anti-Friction Metallic wick, self-oiling bearings, and Ball Bearings if the purchaser prefers.

SEYMOUR FANS are not an experiment. Over 100,000 now in service. Built of the best materials. Good Workmanship. Commercially Attractive Prices.

SEND FOR BULLETINS



Fargo High School, Fargo, N. D., W. B. Ittner, St. Louis, Mo., Architect, T. P. Riley, Fargo, N. D. Heating Contractor.

Clean, Fresh, Pure Air—Washed, Cooled, Humidified

Washing and purifying, cooling and humidifying, the American Blower Air Washing and Cooling Fan supplies a large volume of pure fresh air and is particularly adaptable for the ventilation of school houses, theaters and public buildings.

This combination unit provides a practical ventilating system and is operated at a cost little greater than that of a ventilating system alone.

It occupies small space and because of its simplicity of operation does not require the services of skilled attendants.

Have you read our Bulletin which contains complete information regarding the American Blower Air Washing and Cooling Fan, as well as capacity table and letters of indorsement from users? We will gladly send you a copy upon request.

AMERICAN BLOWER COMPANY, DETROIT
BRANCH OFFICES IN ALL PRINCIPAL CITIES
CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO

(201)

American Blower

"Sirocco" TRADE MARK

EXHAUSTERS · VENTILATING FANS · AIR WASHERS · BLOWERS · ENGINES
FOR HEATING, VENTILATING, DRYING, AIR CONDITIONING, MECHANICAL DRAFT

Manufacturers' Notes.

Bishop & Babcock Co., Cleveland, O., announces the appointment of The Neser & Quinn Company, Lexington and Greene Streets, Baltimore, Md., as direct factory representatives in the Batimore district, to handle the B. & B. line, including the B. & B. all-metal temperature control system and the B. & B. service, covering the various types of vapor, vacuum, steam and water heating installations.

Warren Webster & Co., Camden, N. J., announces the opening of an office in Los Angeles, Calif., at 306 Crocker Street. It will be operated as a direct branch office, with no connection with any other office and will be in charge of R. M. Gunzel. A direct branch office has also been opened in San Francisco, at 171 Second Street, in charge of Paul W. Beggs.

Crane Co., Chicago, Ill., is buildng a new factory branch in Buffalo, N. Y., at Church and Fourth Streets, to cost $100,000. This company is also planning to establish a branch plant in Richmond, Va.

Wilson Welder & Metals Co., 132 King St., New York, is now represented exclusively in Maryland, Virginia and the District of Columbia by the Alexander Milburn Company, of Baltimore. In addition to carrying a large stock of Color-Tipt welding metals and Plastic-Arc welding machines, the company will maintain a complete demonstration plant in operation.

Success Heater & Mfg. Co., Des Moines, Ia., manufacturer of the Success line of warm-air furnaces, has appointed L. G. Colburn sales manager.

Ingersoll-Rand Co., and the A. S. Cameron Steam Pump Works, New York, announce the opening of a branch office in Buffalo, N. Y., at 718 Ellicott Square. This new office, it is stated, is equipped to render full service in vacuum pumps, air, gas and ammonia compressors, turbo blowers and compressors and other products of these companies.

Westinghouse Electric & Mfg. Co, East Pittsburgh, Pa., is building a six-story structure on a lot 100 x 150 ft. at Jones Avenue and Marietta Street, Atlanta, Ga., at a cost of $360,000. The building, which will be known as the Westinghouse Electric Bulding, will be used as an office, warehouse and service station. Construction work started December 1.

Florandin Equipment Co., 110 West 40th Street, New York, which was recently organized as manufacturers' representatives, is acting as New York representative of the Conveyors' Corporation, of Chicago, and is also representing the Perfection Grate & Supply Co., of Springfield, Mass., manufacturer of hand stokers and soot cleaners.

O-E Specialty Mfg. Co., Milwaukee, manufacturer of the O-E line of vapor-vacuum and pressure heating specialties, pressure-reducing valves, air compressors, etc., has just completed the first unit of its new factory building. This building is of steel and concrete construction and is equipped with the latest types of automatic machines, turret lathes, etc., which will enable the company to increase its output over 100%. In addition to the office and factory, the building will contain a laboratory, special testing rooms,

NEW PLANT OF O-E SPECIALTY MFG. CO. MILWAUKEE, WIS.

Massachusetts Blower Co.

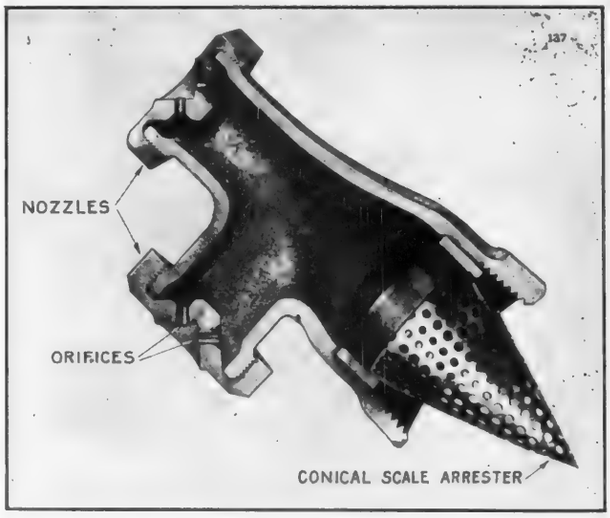
Watertown, Mass.

Are fulfilling the specified requirements of Architects and Engineers the world over.

DEL & HUDSON OFFICE BLDG & STA WITH ALBANY JOURNAL BLDG

There are ten Massachusetts Fans in the ventilating equipment of the above Building.

Massachusetts Fans are built for all requirements of Public Buildings, Power and Industrial Plants.



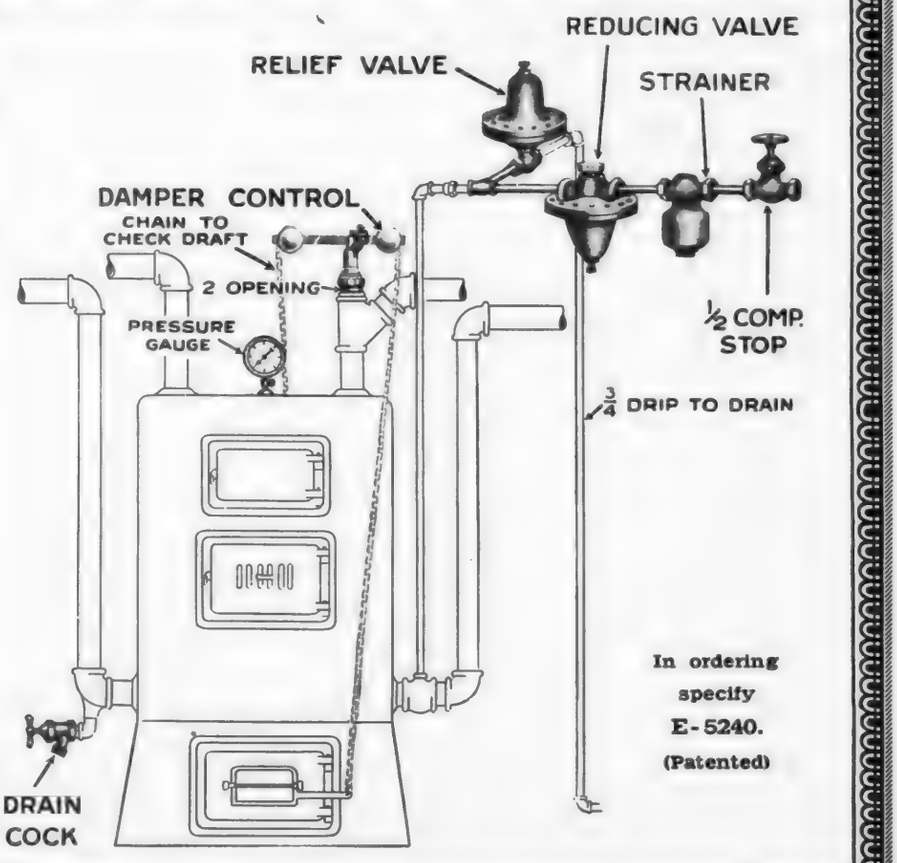
THE IMPACT AIR WASHER

The cut indicates a longitudinal section through a spray head, showing the two impact nozzles with their smooth, round orifices, entirely devoid of obstructing vanes or spiral passages. The conical scale arrester, with its numerous holes, each smaller than the nozzle orifice, intercepts and retains all dirt and scale large enough to plug the nozzles. During this slow accumulation the nozzles spray at full capacity.

Ask for Booklet K.

THE COOLING TOWER CO., Inc.

15 John Street, New York



How to Prevent Future Complaints

You can stop future complaints from your customers regarding their heating systems by selling them the

Mueller Automatic System of Hot Water Heat Control

It gives them automatic control of the heat. It can be set for any desired temperature. It has no expansion tank. It requires no care. It gives no trouble.

A good profit to you, and absolute satisfaction to your customers at a fair price. Write for particulars and prices.

H. MUELLER MANUFACTURING CO., Decatur, Ill., U. S. A.

PHONE BELL 153

Water, Plumbing and Gas Brass Goods and Tools

New York City, 145 W. 30th St.
Phone Watkins 5397

Sarnia, Ontario, Canada

San Francisco, 635 Mission St.
Phone Sutter 3577

Mueller Metals Co., Port Huron, Mich., Makers of "Red Tip" Brass Rod; Welding Rod; Brass and Copper Tubing; Forgings and Castings in Brass and Bronze; also Brass Screw Machined Products.

deep wells, showrooms, etc. The officers of the company are; President and treasurer, John R. Ball; secretary, Homer S. Rogers; vice-president and sales manager, Lewis F. Ostrander.

Duro Pump & Mfg. Co., Dayton, O., manufacturer of Duro residence water systems, whose unique sales campaign was described in last month's issue, reports that the final returns showed an increase in sales of 235.6% during the period from November 13 to December 16. One salesman, H. A. MacManus, of Florida, ran 670% over his quota. Orders in hand, it is stated will keep the Duro factory working full time throughout the winter.

Portland Foundry Co, Portland, Conn., has purchased the business of the John T. Young Co., Norwich, Conn., manufacturer of Red Jacket, New Queen, Vulcan, Young and Norwich warm-air heaters. It is the intention of the company to combine the best features of these different heaters into one super-heater which will be placed on the market under the name of the Portland. Extensive alterations have been going on at the Portland foundry for some time, including the installation of new equipment and it is expected that the capacity of output will be increased over four times within the next six months. The Portland company for many years has been making the castings for the John T. Young Company's line.

Ohio Injector Co., Wadsworth, O., has increased its capacity by the erection of a three-story building to be used exclusively for the manufacture of brass and iron valves. Work has also been started on a three-story building to be used for brass finishing work.

J. L. Purcell, Inc., Hartford, Conn., recently organized to conduct a jobbing business in heating and plumbing supplies, has taken permanent quarters at 25 Hoadley Place.

Autovent Fan & Blower Co., Chicago, Ill., has established an engineering service for the benefit of engineers, architects and contractors in connection with ventilation, heating, drying and exhausting problems.

Crane Co., Chicago, Ill., has elected L. P. Ordway, of St. Paul, Minn., as one of its directors. Mr. Ordway is vice-president and general manager of the Crane & Ordway Co., of St. Paul, Minn., and has been associated with the Crane Company for the past 30 years.

Jenkins Bros., New York, is planning a large addition to its manufacturing plant in Bridgeport, Conn., which will be built at an estimated cost of $250,000.

Continental Heater Corporation, Dunkirk, N. Y., is completing an addition to its foundry which, with other recent additions, will increase its capacity 50%. The company is now manufacturing the Bernhard line of heating boilers.

Minneapolis Heat Regulator Co., Minneapolis, Minn., has recently renewed its articles of incorporation and has increased its capital stock from $500,000 to $1,500,000.

Central Station Heating Notes.

Vancouver, B. C.—A franchise to build and operate a central steam heating system in Vancouver has been awarded to Adkinson & Dill, acting for the Vancouver Steam Company. The firm has deposited $10,000 with the city council to insure its going forward with the work. The agreement stipulates that the company will have a mile of steam mains in operation within one year, and an additional mile of mains in operation within two years. Later advices state that the proposition was turned down by the tax-payers at a special election.

Peoria, Ill.—An increase in the steam heating rates in Pekin, Ill., which, it is claimed, were put into effect without an order from the Public Utilities Commission of the State or notice to the city, was the cause of a vigorous protest on the part of consumers who had their first notification of the increase when they received their bills.

New Incorporations.

Efficiency Oil Burners, Inc., 32 Broadway, New York, capital $100,000, to manufacture oil burners and heating specialties. Incorporators: Harvey A. Willis, James McNaught and Henry Holmes.

Caton Pipe & Fittings Co., Detroit, Mich., capital $20,000, to manufacture pipe

The Porbeck Improved Heater

meets the difficulties of garage heating with efficiency and economy.

Low in first cost and low cost of operation.

Burns coal, coke, oil and wood. No need of ducts or distributing pipes.

Adapted for any size building.

Send for descriptive matter.

PORBECK MANUFACTURING CO.
1000 N. Market St.
ST. LOUIS, MO.

Cycloidal MULTIVANE FANS
TRADE MARK

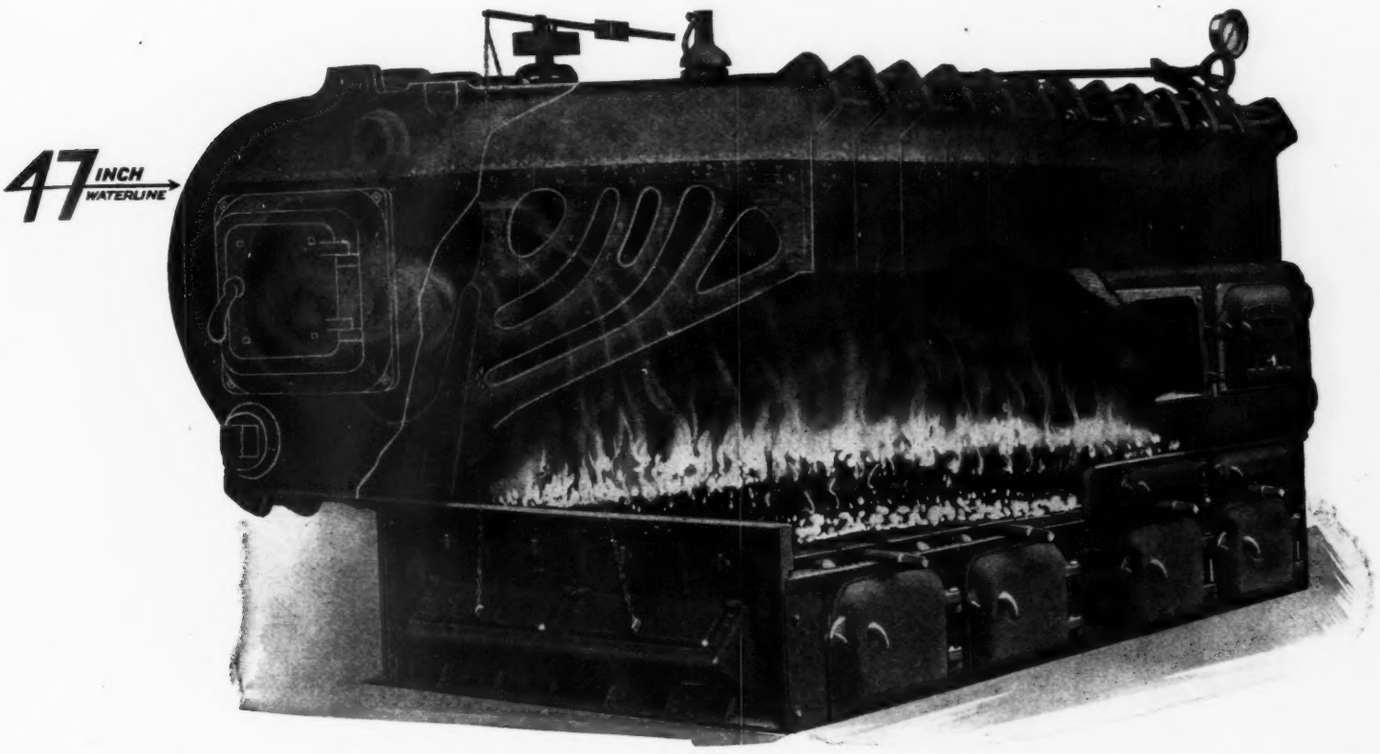
Heating and
Ventilating
Apparatus
Fans and
Blowers

Garden City Fan Co.
Manufacturers since 1879
McCormick Bldg.
CHICAGO

Eastern Office
Cochran & Wrightson
47 W. 34th Street
New York

THE LOW WATER LINE BOILER

47 inch Water Line	2500 to 22,300 square feet steam capacity	**40 Series Boiler**
43 inch Water Line	1200 to 8200 square feet steam capacity	**30 Series Boiler**



Continental Low Water Line Boiler

Smokeless and Regular Types

" . . . . . depending on the efficiency of the boiler."

BUILDERS and owners now recognize the advantage of having an engineer lay out their heating system. Your client will obtain the full value of a well-designed heating system only if a reliable boiler is specified. ***Too much*** depends on the efficient boiler for you to take any chance on new, untried products.

THE Continental Low Water Line Boiler is a proven success. It has been manufactured for years, with installations in every state of the Union. The noteworthy efficiency as appreciated by the consumer and heating engineer is best illustrated by the number of Continental Low Water Line Boilers that have been installed in ***greenhouses, theatres, schools, and hospitals,*** where heat, and ***plenty of it*** is necessary ***all*** of the time, no matter what the temperature outside.

WE welcome opportunities to give further information and to make quotations.

Continental Heater Corporation

Dunkirk, N. Y.

Manufacturers of Cast Iron Boilers and Radiators

Contento Boilers—for either first floor or basement installations.
Continental 13" and 17" Boilers—for the average residence.
Continental Low Water Line Boilers, regular and smokeless types—built to heat any size building.

and engineering products. For the present the company will operate chiefly as jobbers of steel supplies. Incorporators: Louis N. Beers and Joseph R. Lee, of Detroit, and Ross R. Caton, 331 Glengarry Ave., Windsor, Ont.

Doan Plumbing & Heating Co., Cleveland, O., capital $10,000. Incorporators: Abe Kaufman, Frank Turhow, Max Kaufman, Joseph Posner and Max S. Uberstine.

Parrott Heater Co., 1428 21st St., Detroit, Mich., capital $10,000 preferred, and 40,000 shares of common stock at $5.00 per share, to continue the business of the same name which was recently dissolved.

Turner Supply Co., East St. Louis, Mo., capital $30,000, to deal in heating and plumbing supplies. Incorporators: Edward Koch, William T. Miller and Arthur Ritsch, all of East St. Louis.

Consolidated Plumbing & Heating Co., 701 Milwaukee Ave., Chicago, Ill., capital $5,000, to manufacture and deal in heating and plumbing supplies. Incorporators: John L. Sunde, John Roloff, H. J. Rosenberg. Correspondent, J. H. Miner, 109 North Dearborn Street.

Protecto Radiator Mantel Co., Detroit, Mich., incorporated to manufacture a combination radiator shield and humidifier. President, C. E. Collins; vice-president, C. R. White; second vice-president, G. Vaivio; treasurer, D. M. White; secretary, H. M. Lau.

Tate, Fisher & Rice Co., Boston, Mass., incorporated to deal in pipe, valves, fittings, etc. President, Charles B. Tate; vice-president, Charles E. Rice; treasurer, Frank S. Fisher.

New Firms and Business Changes.

Griffin, Lamping and MacLachlan, Chicago, Ill., has been organized by Walter H. Griffin to act as distributor for the Mouat heating system in Illinois, Wisconsin and Minnestota. Mr. Griffin was formerly a sales engineer for the American Radiator Company in Cleveland.

Alfred S. Kellogg, Boston, Mass., has retired from the firm of Brainerd, Leeds & Kellogg, architects and engineers, and has established a consulting engineering office at 89 Franklin St., Boston, for the practice of power plant, heating and ventilating and electrical engineering.

Starrett Bros., 101 Park Ave., New York, is the title of a new firm in the construction field, composed of Paul Starrett, formerly president of the George A. Fuller Company and W. A. Starrett, formerly a vice-president of the same company. For thirteen years William A. Starrett was a member of the firm of Thompson, Starrett & Co., during five years of which he had charge of all construction work. Later he became senior member of the firm of Starrett & Van Vleck, architects, New York, still later becoming associated with the George A. Fuller Company in an executive capacity.

Becker-Seidel Co., 324-328 Prospect Ave., N. W., Cleveland, O., heating and power piping contractors, announces that it has established a plumbing department which will be in charge of William Greller, formerly of the Wm. Greller Co., of Cleveland. The Becker-Seidel Co., which has been in the heating and ventilating business for the past 15 years, has handled some of the largest installations in the Middle West, while the Wm. Greller Company has had the same record in the plumbing field.

Contracts Awarded.

P. W. Schneider, Inc., Utica, N. Y., installing two boilers in the Roscoe Conkling School, in Utica, for $40.250.

E. G. Woolfolk Co, New York, heating and ventilating new Charles E. Gorton High School in Yonkers, N. Y., for $102,679. The plumbing contract went to William Colquhoun, New York, at his bid of $31,249.

Edwin P. Ambler, St. Louis, Mo., heating and ventilating Walbridge and Long Schools, in St. Louis, for $70,104.

Bradley Heating Co., St. Louis, Mo., heating and ventilating Sumner High School addition for $11,900. The plumbing contract for this building, as well as for the Walbridge and Long Schools, went to the J. Sheehan Plumbing Co., of St. Louis, at its bid of $38,421.

New List Prices of Radiator Valves and Elbows.

A notice issued to the trade and which has been concurred in by practically all of the manufacturers of radiator valves, states that new list prices on radiator valves and elbows would become effective January 1. The purpose of the new list, it was stated, is to correct inequalities which have existed for some time among the several sizes and groups of this line. The list prices which are now superseded were established many years ago and did not take account of the changed conditions in the industry. In the new list, the prices are given as follows:

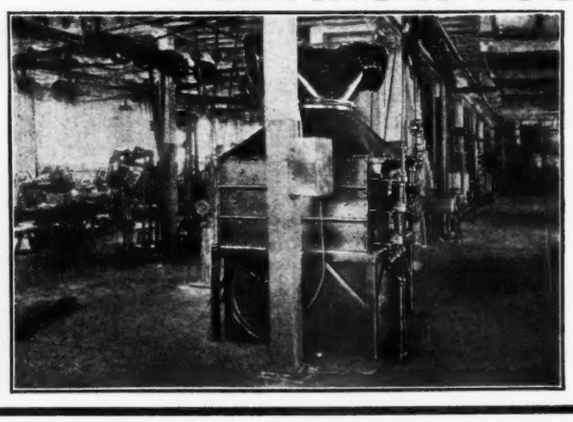
Steam radiator valve, angle type, with union, composition disc.

Inches Diameter	Price, each
½	$3.70
¾	4.30
1	5.10
1¼	6.40
1½	8.40
2	13.60

Steam radiator valve, corner type, with union, composition disc.

½	$4.10
¾	4.75
1	5.60
1¼	7.05
1½	9.25
2	15.00

HEATING A ROOF IS POOR ECONOMY!



Investigate the temperature at the ceiling or underneath the roof beams of any large industrial plant heated by direct radiators or pipe coils, and you will find it very much in excess of that at the floor or working level. Circulation with direct radiators depends upon gravity; warm air rises to the ceiling, colder or heavier air drops to the floor; result—cold floor and overheated ceiling *with enormous waste of fuel.*

Compare this with the operation of *Wing-Scruplex Unit Heaters.* The air is heated and directed *downward* toward the floor or working level. The circulation is positive and uniform without the use of distributing ducts or pipes. This is but one way they economize.

Wing-Scruplex Unit Heaters cost less to install and to operate than any other known system.

Write us for full particulars.

L. J. Wing Mfg. Co.

Fans and Blowers — Unit Heaters
Small Turbines — Damper Regulators
HUDSON & 13th STS., NEW YORK CITY

STEAM TRAPS AIR TRAPS — STEAM SEPARATORS EXHAUST HEADS — OIL SEPARATORS BOILER ALARM WATER COLUMNS — STRAINERS

WRIGHT — WA Steamfitters Steam Users Since '94 — AUSTIN

WRIGHT-AUSTIN CO. — DETROIT, MICHIGAN

Peerless Ventilator

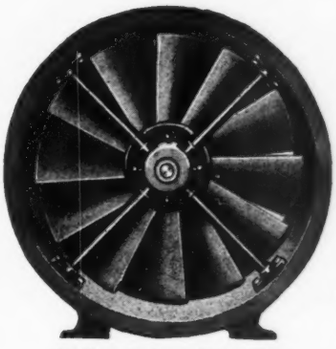
BUILT RIGHT RUN RIGHT

The New York Blower Co.

Chicago, Ill. La Porte, Ind.

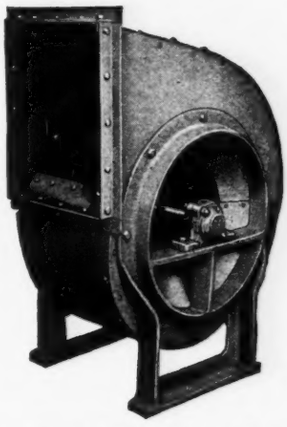
Peerless Air Washer

We manufacture a complete line of fan equipment and appurtenances. By concentrating on this one class of products we are able to make them better every year.



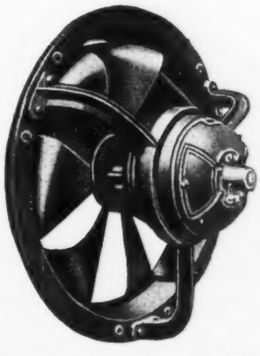
Pulley Driven Disc Fan for Mines

The old fallacy that fan equipment was a luxury is now known to be untrue; it is an economical necessity. We can give actual installations in all kinds of industries where through the wise employment of fan equipment manufacturers have improved the quality of their product, and increased production with a reduction in factory cost.



Type "C" Seri-Vane Fan

If you are interested in drying, humidifying, heating, ventilating, mechanical draft, removal of shavings or similar installations, please communicate with us. If we cannot honestly prove facts to you showing the benefits that will follow from an installation for your special problem, we will frankly so state.



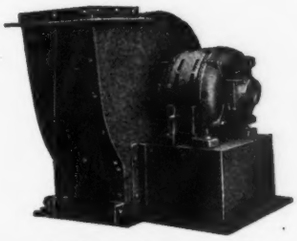
Motor Driven Propeller Fan

Slow Speed Planing Mill Exhauster

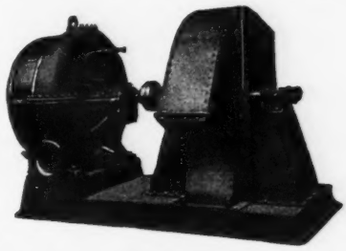
The New York Blower Co.

Chicago, Ill. La Porte, Ind.

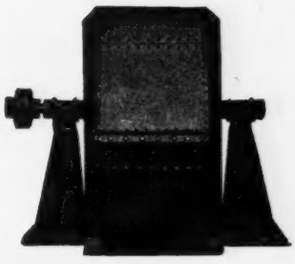
Branch Offices in Principal Cities



High Speed Type "C" Seri-Vane Fan



High Pressure Blower Direct Connected to Turbine



Stoker Fan

Water radiator valve, angle type, with union.

½	$3.25
¾	3.70
1	4.50
1¼	5.75
1½	7.30
2	12.00

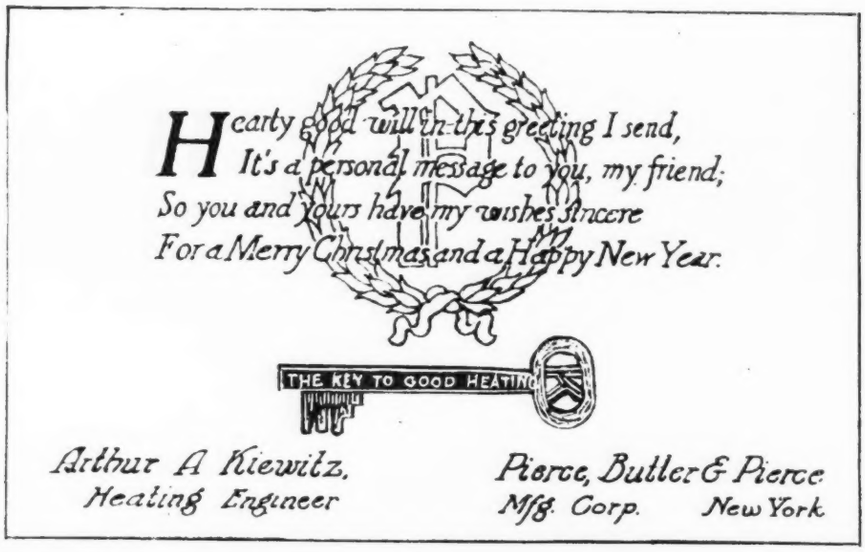
Union elbows.

½	$1.75
¾	2.00
1	2.50
1¼	3.30
1½	4.25
2	7.20

All of the above cover valves and elbows with rough body, polished trimmings, nickel-plated all over.

Unique Form of Christmas Card.

Novelty and effectiveness are combined in the Christmas greeting card received from Arthur A. Kiewitz, heating engineer with the Pierce, Butler & Pierce Mfg. Corporation, New York, and shown in the accompanying reproduction.


Hearty good will in this greeting I send,
It's a personal message to you, my friend;
So you and yours have my wishes sincere
For a Merry Christmas and a Happy New Year.
THE KEY TO GOOD HEATING
Arthur A Kiewitz,
Heating Engineer
Pierce, Butler & Pierce
Mfg. Corp.
New York

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

WANTED—Heating, ventilating and sanitary engineer for well-established contracting concern in the East. Must be capable estimator on both plumbing and heating, do his own drafting and make layouts on both branches of work. State age, experience and salary wanted. Address Box 25, care of Heating and Ventilating Magazine.

WANTED—Heating and ventilating engineer. Must be experienced in the design of fan and direct radiation systems of steam heating. One with practical experience and well versed in vacuum systems preferred. Address P. O. Box 317, Saginaw, Mich., giving full particulars.

WANTED—By large manufacturer, salesman to sell material to plumbing and heating trade in Philadelphia and vicinity and in Pittsburgh. State age, experience, etc. Correspondence strictly confidential. Address Thompson, care of Heating and Ventilating Magazine.

WANTED.—Draftsman familiar with heating and ventilating layouts, for engineering firm in New York City. State experience and salary. Address Endicott, care of Heating and Ventilating Magazine.

EFFICIENT VENTILATION

Can be obtained only through the use of equipment designed to meet the specific requirements for which it is intended.

Bayley Plexiform Fans

are made in a variety of capacities, from 300 to 300,000 cubic feet per minute. They are designed especially with a view of handling a maximum volume of air from a minimun of space and power requirement. Their efficiency as proved by installations in thousands of the largest industrial, public, school, theatre and office buildings, makes them prime favorites with architects, engineers and owners.

Write for Catalog

Bayley Mfg. Co.
Dept. (E)
Milwaukee, Wis.

REAL OPPORTUNITY
for
SALES REPRESENTATIVES

For a quarter century, we have manufactured hand stokers, gravity stokers and grates of a superior type. We are firmly entrenched in our field. Now we are offering a hand stoker which we guarantee to:—

—Save 10% to 30% fuel.

—Eliminate Smoke.

—Get more power out of coal consumption.

These stokers are in successful operation in many of the most prominent office, industrial and apartment buildings in the country. They are a success and should attract heating and power apparatus salesmen, preferably those who have an established clientele.

To the man who qualifies in each territory, an attractive sales proposition will be made. He must be of ripe judgment and experience, able to meet big men on an equal footing and produce results. Such men will be backed intensively by the home office, furnished leads from our advertising and given every possible cooperation. In your letter, tell everything which will enable us to judge you fairly and state what headquarters you propose to maintain and what territory you propose to cover. We have no objection to men selling non-competing heating or power apparatus.

Write at once in full and

Address H. W. S.
21st Floor, Wrigley Bldg, Chicago, Ill.